TEXAS INSTRUMENTS

Topics in **Algebra 1**



Texas Instruments

Topics in Algebra 1

Software Application
for the
TI-83 Plus and the TI-73

Student and Teacher Classroom Materials Chapters 1 – 5

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Introduction to Topics in Algebra 1

Note to Teachers

Welcome to the Topics in Algebra 1 software application for the TI-83 Plus and TI-73 graphing calculators. The application and Classroom Materials were designed to help students review and reinforce selected concepts taught at the Algebra 1 level. Topics in Algebra 1 is easy to use, even for inexperienced calculator users, and it encourages students to explore concepts on their own.

Navigating Topics in Algebra 1 (pages vi–ix) explains how to move around the application. You may wish to copy these pages for your students.

We hope Topics in Algebra 1 proves useful to you and your students. All of your comments and suggestions are appreciated. You can contact TI:

- Phone 1-800-TI-CARES (1-800-842-2737)
- E-mail ti-cares@ti.com
- TI website education.ti.com

Organization of Topics in Algebra 1

Topics in Algebra 1 is organized in textbook fashion with chapters and sections arranged in table-of-contents form.

Chapters	Sections
1: Number Sense	1: Integers 2: Rational Numbers 3: Real Numbers
2: Linear Equations	1: Using Graphs & Tables 2: Using Algebra
3: Linear Functions	1: Slope with Grid 2: Slope Using Coordinates 3: Slope Rate of Change 4: Slope-Intercept Form
4: Linear Inequalities: 1-Variable	1: Using Graphs & Tables 2: Using Algebra

Note: Chapters can be installed and deleted individually. This provides flexibility, allowing calculators to have only the applications students currently need.

Each section in the application contains three subsections.

- The **Overview** presents definitions and concepts for teachers to use in class discussions and for students to use for study and review. They contain animation and real-world examples.

- The **Observations** show concepts or examples, followed by **Write An Observation** screens. Students are asked to write in the space provided on the Student Worksheet their observations about the content presented. Screens entitled **Did you know** display additional information and facts about the current concept.

- The **Activities** include interactive activities that reinforce the concepts covered in the section. Many of the activities are in the form of games. Students can practice calculating equations with integers, rational numbers, and real numbers, or they can find the equation of a line. The application checks answers, gives a score, and provides students with the correct answer if they are unable to answer a question correctly. In the Linear Functions chapter, students can play a game called Screen Cross where they link to each other's calculators and race to see who finishes first.

Classroom Materials

The Topics in Algebra 1 Classroom Materials include Student Worksheets, Teacher Notes (with answers), and TIps™.

- Student Worksheets provide explanations and instructions to students about using the application to review the concepts in the section. Each worksheet is divided into four parts—**Overview**, **Observations**, **Activities** (which correspond to the subsections of the application), and **Try-It!™ on Your TI-83 Plus or TI-73**.

 Try-It!™ activities let students investigate specific features on the calculator related to the section concepts. This includes step-by-step instructions with the exact keys to press to complete each step and corresponding screen pictures. The screens shown in the **Try-It!** activities are for the TI-83 Plus. Usually, the TI-73 display varies only slightly, and the students should have no problems following the instructions. However, in the cases where the two calculators vary, the Try-It! activities contain two separate exercises, one for each of the two calculators. Therefore, you only need to copy the section appropriate for the calculator that you use in your classroom.

- Teacher Notes give a brief explanation of the concepts covered in the section, some of the common student errors that might be encountered, and answers to the questions on the Student Worksheets. There are Teacher Notes for each Student Worksheet.

- TIps™ provide keystroke examples for some of the more common tasks that you and your students need for Algebra 1 and beyond. The TIps are intended to help students learn how to use the features of the calculator. The TIps topics are:

 - TIp 1: *Resetting Your Calculator*
 - TIp 2: *Adjusting Your Calculator Settings*
 - TIp 3: *Graphing a Function in the Standard Window*
 - TIp 4: *Creating a Table*
 - TIp 5: *Adjusting the Viewing Window*
 - TIp 6: *Using Lists*
 - TIp 7: *Creating a Statistical Plot*
 - TIp 8: *Finding the Best Line of Fit for a Set of Data*
 - TIp 9: *Sending and Receiving Data between Calculators*
 - TIp 10: *Managing Your Calculator's Memory*

 When students need to learn how to use the feature being covered, you can distribute the TIps to them to make sure they are prepared for the lesson.

NCTM Principles and Standards for School Mathematics

The Topics in Algebra 1 application and the Classroom Materials were written with the guidelines of the NCTM *Principles and Standards for School Mathematics* in mind. Attention was paid to the expectations laid out for the Algebra Content Standard for the Algebra 1 level that crosses the 6–8 and 9–12 grade bands.

Some examples include:

NCTM Standards and Expectations	On the Application
To understand patterns, relations, and functions.	Students see how battery voltage values in a series can be represented by a linear function.
To model and solve contextualized problems using various representations, such as graphs, tables, and equations.	Students experience how to work with tables of values, graphs, and linear equations to see the multiple approaches to problem solving.
To analyze the nature of changes in quantities in linear relationships.	Students determine the constant rate of change of a diving submarine along each segment of its dive.

In addition, scored, interactive activities at the end of each section help reinforce the concepts reviewed in the **Overview** and **Observations** subsections.

You can find the complete expectations for the Algebra Content Standard and for the various grade bands set out by the NCTM at:

http://standards.nctm.org/document/appendix/alg.htm

You can view the NCTM *Principles and Standards for School Mathematics* online at:

http://standards.nctm.org/

Acknowledgements

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Installing This Application

Students may install all four chapters as a unit (**ALG1PRT1**) or one or more of the chapters individually (**ALG1CH1**, **ALG1CH2**, **ALG1CH3**, **ALG1CH4**). This provides flexibility, allowing calculators to have only the applications students currently need. When two or more chapters are installed separately, they each must be accessed directly from the [APPS] menu.

Installing this application requires TI-GRAPH LINK™ software and link cable. A link cable can be purchased from the online store:

http://epsstore.ti.com

If an **Archive Full** error message appears while installing Algebra 1 or one of the chapters, the calculator does not have sufficient memory for the application. Applications and/or archived variables must be deleted to make room (see below).

Deleting an Application

Deleting an application completely removes the application from the calculator. The space then becomes available for a different application. The deleted application may be reloaded at a later date. Before deleting an application from the calculator, it can be backed up to a PC using the **Link > Receive Flash Application** menu in TI-GRAPH LINK. You can reload it to the calculator later using the **Link > Send Flash Software** menu in TI-GRAPH LINK.

To delete an application or archived variable:

1. Press [2nd] [MEM] to display the **MEMORY** menu.
2. Select **2:Mem Mgmt/Del** (**4:Delete…** on the TI-73).
3. Select **A:Apps...** or **B:AppVars...** (**8:Apps...** or **9:AppVars...** on the TI-73).
4. Press [▼] until the ▶ indicator is next to the item you wish to delete.
5. Press [DEL] ([ENTER] on the TI-73).
6. Select **2:Yes** when asked **Are You Sure?**
7. Press [2nd] [QUIT] to return to the Home screen.

Navigating Topics in Algebra 1

Starting the Application

1. Press [APPS] to display the **APPLICATIONS** menu.
2. Press [▼] until **ALG1PRT1** (or a chapter such as **ALG1CH1**) is highlighted, and then press [ENTER] to select it. The application title page is displayed.



Topics in Algebra 1 title page

3. Press any key to start the application.

A Table of Contents page is displayed. It is the Table of Contents from which you last exited Algebra 1. You may select one of the items on the menu or press ⟨**UP**⟩ as often as necessary to go to the Table of Contents screen that you need.

Table of Contents Screens

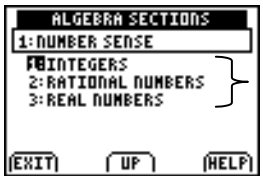
There are three types of Table of Contents screens—chapters, sections, and subsections.



Algebra Chapters

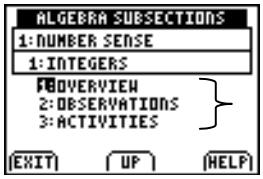
Note: If you have installed the chapters individually, only the current chapter is shown on this screen. Press [ENTER] to select the chapter.

When you select a chapter, the **Algebra Sections** screen is displayed. The number of sections listed varies according to chapter.



Algebra Sections

When you select a section, the **Algebra Subsections** screen is displayed. The items listed are always the same—**Overview**, **Observations**, and **Activities**.



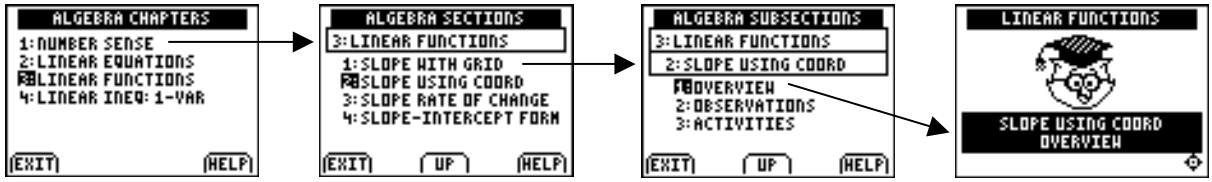
Algebra Subsections

Note: When you exit and re-enter Topics in Algebra 1, you return to the Table of Contents screen from which you exited.

Navigating Topics in Algebra 1 (continued)

Selecting the Chapter, Section, and Subsection You Want

To select from a Table of Contents screen, press ▼ if necessary to highlight the name of the chapter, section, or subsection, and then press ENTER.



When the **Overview**, **Observations**, or **Activities** opening screen appears, press ▶ to begin.

Returning to the Table of Contents

From most **Overview**, **Observations**, or **Activities** screens, you can press 2nd [QUIT] as many times as necessary to return to the Table of Contents. You may then select one of the items on the menu or press ⟨**UP**⟩ to go to higher levels of the Table of Contents.

Note: If you see ⟨**CONT**⟩ on the current screen, you must first press any key to continue.

Leaving the Application

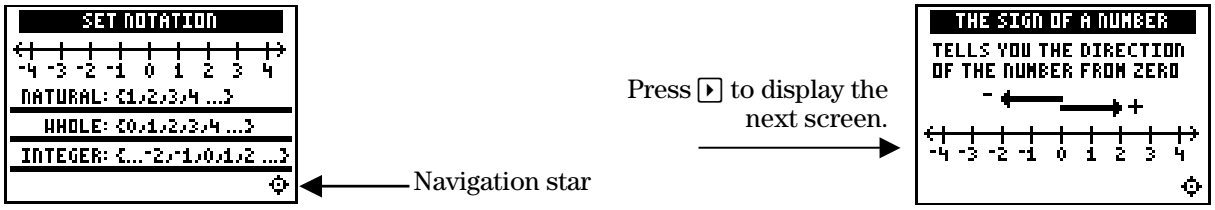
To leave the application, press 2nd [QUIT] as many times as needed to return to a Table of Contents screen, and then press ⟨**EXIT**⟩. When you re-enter the application, you return to this Table of Contents screen.

Navigating Topics in Algebra 1 (continued)

Navigation Star

The navigation star is located on the bottom right of most **Overview** and **Observations** screens.

When the right and left arrows of the navigation star are flashing, press ◄ and ► on the calculator to page back and forward between screens. When the up and down arrows are flashing, ▲ and ▼ are used to navigate vertical menus (see below).

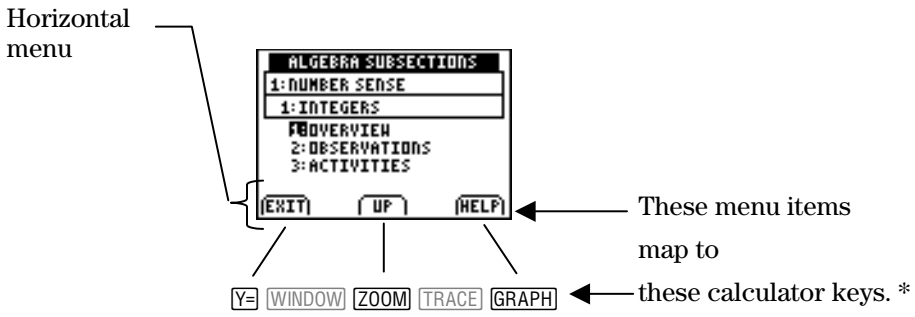


Horizontal Menus

A horizontal menu may be displayed at the bottom of the screen. The menu items help you move between screens in the application. The menu items change from one screen to another. The following are the most frequently displayed menu items.

Menu Item	Press	To Do This
⟨**EXIT**⟩	Y=	Exit the application.
⟨**UP**⟩	ZOOM	Move up a level in the menu structure.
⟨**HELP**⟩	GRAPH	Display the **HELP MENU**.
⟨**MAIN**⟩	Y=	Return to the previous screen from the **HELP MENU**.
⟨**BACK**⟩	WINDOW	Return to the **HELP MENU** from a **HELP** explanation screen.
⟨**MENU**⟩	Y=	Return to the previous menu screen.
⟨**QUIT**⟩	Y=	Quit an activity.

To select a menu item, press the calculator key that corresponds to the menu item on the screen.



* In these materials, the items in the horizontal menus are shown in angle brackets; for example ⟨**EXIT**⟩, ⟨**UP**⟩, and ⟨**HELP**⟩.

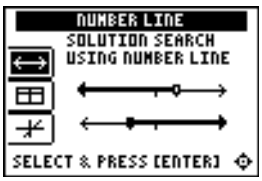
The menu items change from one screen to another. On some screens, different menu items are mapped to the calculator keys.

Navigating Topics in Algebra 1 (continued)

Vertical Menus

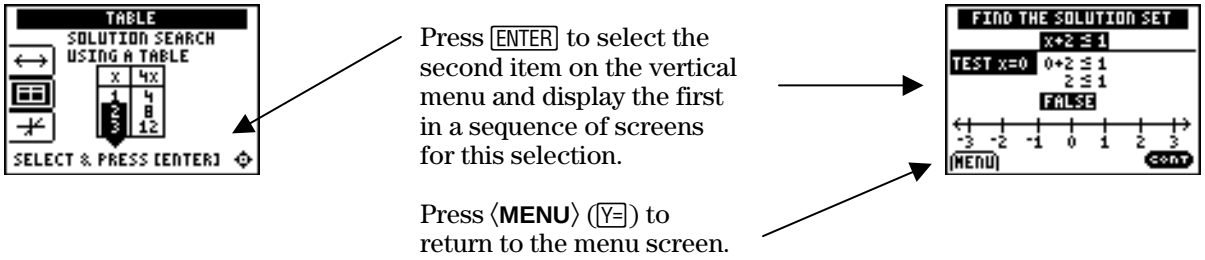
When the up and down arrows of the navigation star are flashing, press ▼ and ▲ on the calculator to highlight an item in a vertical menu.

Vertical menu
First item is highlighted.



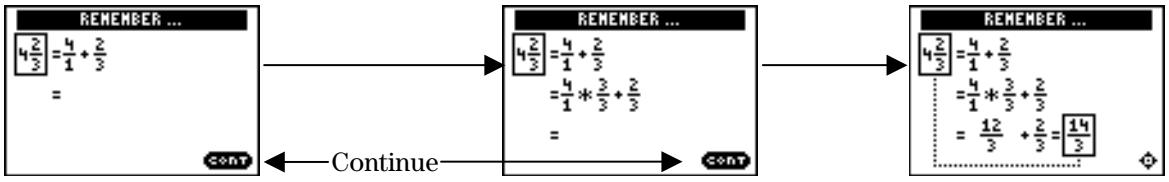
As you press ▼ and ▲ to move through the menu, additional information is displayed to the right of the menu.

Some vertical menus only provide information. Other vertical menus are used for navigation. If **Select** or **Select & Press [Enter]** is displayed, you can press ENTER to select an item or to see more information.



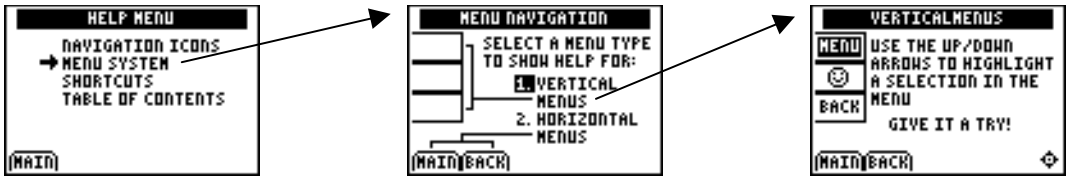
⟨CONT⟩

When you see ⟨**CONT**⟩ (continue), you can press any key to go to the next screen.



HELP

From a Table of Contents screen, press ⟨**HELP**⟩ to view information about features of the application. To select an item, press ▼ to highlight it, and then press ENTER.



Name _____
Date _____

Number Sense: Integers — Student Worksheet

Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

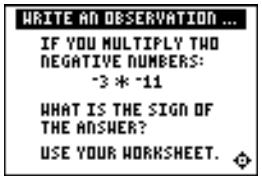
Observations

The **Observations** illustrate number sense concepts relating to the set of integers. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



Observation 1

How far apart are the bird and the fish? Should your answer be positive or negative? Write an explanation for your answers here.



Observation 2

What is the sign of the answer to the problem $^{-}3 \times {}^{-}11$?

In your own words, state the rules for multiplying and dividing signed numbers (shown in the grids on the next screens).

Name _____
Date _____

Activities

The **Activities** help you practice integer concepts. You can select from two different activities—**What Is My Sign?** and **Integer Smash**. Follow these steps to play the activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.
2. Highlight an activity using ▲ or ▼, and press ENTER.



Scoring: Every correct response earns 2 points.

The game automatically ends if you have answered incorrectly four times (shown in the top right corner), or you press 〈**QUIT**〉 to stop.

What Is My Sign?

1. In your head, quickly solve the sliding expression to determine if the result is positive, negative, or zero.
2. As soon as you know the sign of the result, press ▼ and ▲ to move the expression into the proper category on the left (**+**, **0**, or **-**). Once the expression is in the correct row, you can press ◀ to slide it quickly to the left. If the answer is incorrect, the correct answer is displayed; press any key to resume play.
3. Follow your teacher's instructions for how long to play the activity.
4. What was your score? _____
5. How many incorrect answers did you have? _____

 (Shown in top right corner of the screen.)

Name _____
Date _____

Activities (continued)



Scoring: You get two attempts to solve each problem. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

You can earn up to 10 points.

Integer Smash

1. Highlight a level (bronze = least difficult; gold = most difficult), and press [ENTER] to select it.
2. For bronze or silver levels only, press ⟨+⟩, ⟨−⟩, ⟨∗⟩, or ⟨÷⟩ to select the operation you want to practice.
3. Enter the missing number (press [(-)] for negative numbers) and press [ENTER]. If the answer is incorrect on the second attempt, the correct answer is displayed; press any key to resume play. As you play the activity, write each number sentence and solution. Show your work here.

4. What level and operation (bronze and silver only) did you play? _____
5. What was your score? _____

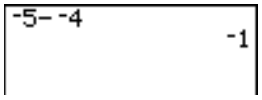
 © 2001 Texas Instruments

Name _____
Date _____

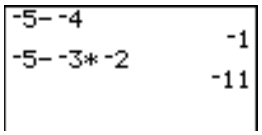
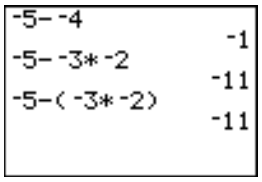
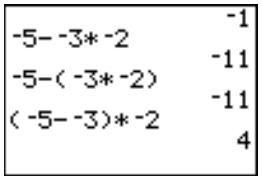
Try-It!™ on Your TI-83 Plus or TI-73

Learn to use the subtraction key ([−]), the negation key ([(-)]), and the absolute value function (**abs(**).

Use the negation and the subtraction keys to calculate -5 − -4.

To Do This	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	[2nd] [QUIT] ⟨**EXIT**⟩ [CLEAR]	
2. Calculate -5 − -4. **Note**: The negation key ([(-)]) and the subtraction key ([−]) are different.	[(-)] **5** [−] [(-)] **4** [ENTER]	

Enter -5 − -3 × -2, first without using parentheses and then using parentheses.

To Do This	Press	Display (TI-83 Plus shown)
1. Calculate -5 − -3 × -2. **Note**: On the TI-73, notice the difference between the x variable key ([x]) and the multiplication key ([×]).	[(-)] **5** [−] [(-)] **3** [×] [(-)] **2** [ENTER]	
2. Calculate -5 − (-3 × -2).	[(-)] **5** [−] [(] [(-)] **3** [×] [(-)] **2** [)] [ENTER]	
3. Calculate (-5 − -3) × -2.	[(] [(-)] **5** [−] [(-)] **3** [)] [×] [(-)] **2** [ENTER]	

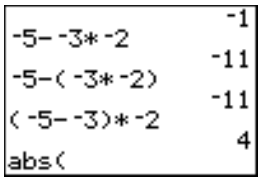
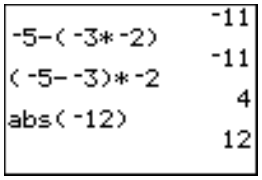
The calculator uses the Order of Operations rules, which say that multiplication and division are performed from left to right, and then addition and subtraction are performed from left to right. Notice that multiplication was calculated before subtraction in the expression -5 − -3 × -2. Notice that the expression -5 − (-3 × -2) has the same answer.

The calculator performs operations inside the parentheses before operations outside the parentheses. Notice that the expression (-5 − -3) × -2 has a different answer than the expressions -5 − -3 × -2 and -5 − (-3 × -2).

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Use the absolute value (**abs(**) function on the calculator to find the absolute value of -12.

To Do This	Press	Display (TI-83 Plus shown)
1. Find the absolute value of -12, which is written as \|-12\|. **Note**: The MATH **NUM** menu varies slightly from the TI-73 to the TI-83 Plus.	MATH ▶	
2. Select the absolute value (**abs(**) function. It is copied to the Home screen.	**1:abs(**	
3. Calculate the result.	(−) **12**) ENTER	

Additional problems—Calculate the following problems by hand, then check your answers using the calculator. Remember to use the Order of Operations rules.

1. $-4 + -12 \times -10 =$

2. $4 \times -8 - -10 \times 2 =$

3. $-30 \div -5 - 6 =$

4. $|-12 + -28| =$

5. $|-4 \times -8 - -10 \times 2| =$

6. $-|-3 - 14 - -10| =$

Number Sense: Integers Teacher Notes

Objectives

- To illustrate the set of integers in a Venn diagram.
- To give an overview of the following definitions: the sign of a number, numbers of opposite sign, and absolute value.
- To give illustrations of the sets of positive and negative integers, and zero.
- To review ordering and the additive inverse property.
- To show examples of addition, subtraction, multiplication, and division of integers.

Math Highlights

This section begins with a Venn diagram and follows with an illustration of the use of integers on the Fahrenheit and Celsius scales. The temperature equivalencies shown are integer values. Students are reminded that the absolute value operation is defined as the distance of the number from zero. Examples of addition, subtraction, multiplication, and division operations are given. A number line model is used for addition and subtraction. Subtraction uses the *add-the-opposite* rule.

Common Student Errors

Students may have trouble identifying rules, such as the *add-the-opposite* rule for subtraction.

Note: The number line model for addition and subtraction is shown on the calculator when the Topics in Algebra 1 application is installed.

Following are some activities to help students construct the rules for multiplication and division. These activities are not part of the Topics in Algebra 1 application.

Pattern Development for Multiplication and Division	
Investigation 1: What is the product of a positive and negative number? Begin by writing the product of two positive numbers, for example, $3 \times 3 = 9$. Keep decreasing the second term by 1 to create the sequence of multiplication values shown to the right. Notice the values on the right side of the number sentences decrease by 3. **Observation:** The product of a positive and negative number is negative.	$3 \times 3 = 9$ $3 \times 2 = 6$ $3 \times 1 = 3$ $3 \times 0 = 0$ $3 \times -1 = -3$ $3 \times -2 = -6$ $3 \times -3 = -9$. . .

Common Student Errors (continued)

Pattern Development for Multiplication and Division (continued)	
Investigation 2: What is the product of two negative numbers? Start with the last number sentence from Investigation 1 ($3 \times -3 = -9$). Keep decreasing the first term by 1 to create the sequence of multiplication values shown to the right. Notice that the values on the right side of the number sentences increase by 3. **Observation:** The product of two negative numbers is positive.	$3 \times -3 = -9$ $2 \times -3 = -6$ $1 \times -3 = -3$ $0 \times -3 = 0$ $-1 \times -3 = 3$ $-2 \times -3 = 6$ $-3 \times -3 = 9$ …
Investigation 3: What are the division rules for multiplying signed numbers? **Observation:** Division rules are developed using multiplication as the inverse operation. The rules are similar.	$-6 \div 3 = -2$ since $3 \times -2 = -6$ $-6 \div -2 = 3$ since $-2 \times 3 = -6$

Student Worksheet Notes with Answers

Overview

Tell students:

1. How to find the **Overview**, if necessary.
2. How to navigate the application, if necessary.
3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

Observations

The **Observations** help students understand operations with signed integers. If necessary, tell students how to find the **Observations**.



Observation 1

How far apart are the bird and the fish? Should the answer be positive or negative? Students write an explanation of their answers.

The bird and the fish are +125 *ft. apart. The distance is positive.* (*Students will see the answers on the next three screens. Signed numbers give a perspective as shown on the screens.*) *Explanations will vary.*

Students see the answers on the following three screens.







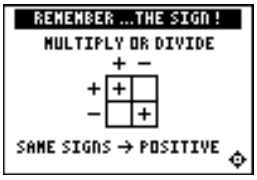


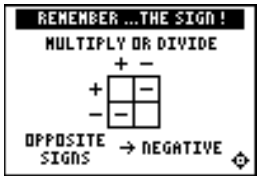
Observation 2

What is the sign of the answer to the problem -3×-11?

The answer is positive. $-3 \times -11 = 33$.

Students see grids explaining the rules.





What are the rules for multiplying and dividing signed numbers?

The product of a positive and negative number is negative.

The product of two numbers with the same sign is positive.

Rules for division are similar to the rules for multiplication.

Activities



Scoring: Students earn 2 points for each correct response.

Unless you specify point or time limits for this activity, students can play the activity until they have answered incorrectly four times or they press ⟨**QUIT**⟩ to stop. There is no time limit.

What Is My Sign?

Tell students to:

1. Quickly solve the expression in their heads before it slides all the way to the left.
2. Move the expression into the correct category (**+**, **0**, or **-**) using ▲ and ▼. Once the expression is in the correct row, they can press ◀ to slide it quickly to the left. If the answer is incorrect, the correct answer is displayed; press any key to resume play.
3. Follow your instructions. For example, students can play:
 - Until they have answered incorrectly four times (no time limit).
 - Until a certain amount of time has expired (highest score with the fewest misses wins).
 - Until a certain score has been reached (first student to reach the score with the fewest misses wins).
 - Repeatedly over a period of time (days, weeks, etc.) for tracking improvement of high scores.
4. Record their score.
5. Record how many incorrect answers they had.

 (Shown in top right corner of the screen.)



Scoring: Students get two attempts to solve each problem. They earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

Students can earn up to 10 points.

Tip: You may want to remind students playing at the gold level about the Order of Operations rules.

Integer Smash

Tell students to:

1. Highlight a level (bronze = least difficult; gold = most difficult), and press [ENTER] to select it.
2. Bronze or silver levels only: Press ⟨**+**⟩, ⟨−⟩, ⟨∗⟩, or ⟨÷⟩ to select the operation that they want to practice.
3. Enter the missing number (press [(-)] for negative numbers) and press [ENTER]. As they play the activity, write each number sentence and solution, showing all of their work on the worksheet.
4. Record the level and operation (bronze and silver only) they played.
5. Record their score.

Try-It!™ on Your TI-83 Plus or TI-73

These keystroke exercises let students practice using the basic operation keys (+, −, ×, ÷), the negation key (−), the parentheses keys (()), and the absolute value function (MATH **NUM 1:abs(**).

Tell students to follow the steps exactly on the calculators. Example screens are displayed on the worksheets for students to compare with the calculator screens.

Additional problems—These problems give students additional practice using the subtraction key (−), the negation key (−), and the absolute value function (MATH **NUM 1:abs(**). Remind them to follow the Order of Operations rules.

Tell students to do the following calculations by hand, and then check the answers using the calculator.

1. $-4 + -12 \times -10 = 116$
2. $4 \times -8 - -10 \times 2 = -12$
3. $-30 \div -5 - 6 = 0$
4. $|-12 + -28| = 40$
5. $|-4 \times -8 - -10 \times 2| = 52$
6. $-|-3 - 14 - -10| = -7$

Name _____
Date _____

Number Sense: Rational Numbers — Student Worksheet

Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

Observations

The **Observations** illustrate number sense concepts relating to rational numbers. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



Observation 1

Write $4\frac{2}{3}$ as an improper fraction.

Write your answer here. Show all of your work.



Observation 2

Write $\frac{5}{8}$ and $\frac{2}{11}$ as decimals.

Write your answer here. Show all of your work.



Observation 3

Write .1875 and $\frac{1}{4}$ as percentages.

Write your answer here. Show all of your work.

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Name _____
Date _____

Activities

The **Activities** help you practice rational number concepts. You can select from two activities—**Slide** and **Number Smash**. Follow these steps to play the activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.
2. Highlight an activity using ▲ or ▼, and then press ENTER.



Scoring: When a row or column adds up to 1, it disappears, and you score 2 points.

The game automatically ends if the screen is full or if you press ⟨**QUIT**⟩ to stop.

Slide

1. Highlight a level (bronze = least difficult; gold = most difficult), and press ENTER to select it.
2. Line up the fractions so they add to 1 (horizontally or vertically). As a fraction slides across the screen, press ▼ and ▲ to move it up or down. Once a fraction is in the correct row, you can press ◀ to slide it quickly to the left.
3. Follow your teacher's instructions for how long to play the activity.
4. What level did you play? _____
5. What was your score? _____
6. Write a paragraph describing the **Slide** activity. What was your strategy for playing the game?

Name _____
Date _____

Activities (continued)



Scoring: You get two attempts to solve each problem. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

You can earn up to 10 points.

Tip: To change an answer before you press ENTER, press CLEAR and re-enter the answer.

Tip: Press ⟨**n/d**⟩ to move between the numerator and denominator.

Number Smash

1. Highlight a level (bronze = least difficult; gold = most difficult), and press ENTER to select it.

2. Press ⟨**+**⟩, ⟨−⟩, ⟨∗⟩, or ⟨÷⟩ to select the operation you want to practice.

3. Enter the missing number (press (-) for negative numbers), and press ENTER. As you play the activity, write each number sentence and solution. Show your work below.

 - To enter a mixed number, enter the whole number and press ⟨**UNIT**⟩. Then enter the fraction.
 - To enter a fraction, press ⟨**n/d**⟩ and enter the numerator. Press ⟨**n/d**⟩ again and enter the denominator.

 If the answer is incorrect, the correct answer is displayed; press any key to resume play.

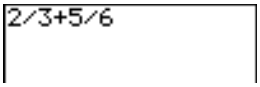
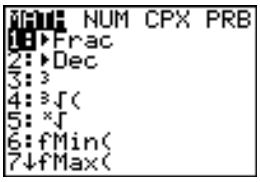
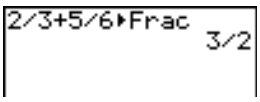
4. What level and operation did you play? _____

5. What was your score? _____

Name _____
Date _____

Try-It!™ on Your TI-83 Plus

Investigate how the calculator computes addition expressions. Solve $\frac{2}{3}+\frac{5}{6}$.

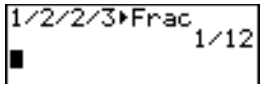
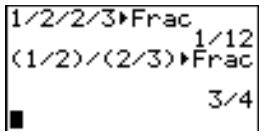
To Do This	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. Enter the expression on the Home screen.	**2 ÷ 3 + 5 ÷ 6**	
3. To specify that you would like the result to be shown in fraction form, select ▸**Frac**. It is copied to the Home screen.	MATH **1:▸Frac**	
4. Evaluate the answer.	ENTER	

Notice that the answer is in simplified form. The calculator follows the Order of Operations rules. Division is performed before addition. Solve this problem by hand. Show all of your work.

Name _____
Date _____

Try-It!™ on Your TI-83 Plus (continued)

Investigate how the calculator computes division expressions. Solve $\frac{1}{2} \div \frac{2}{3}$.

To Do This	Press	Display (TI-83 Plus shown)
1. Solve without parentheses and specify that you want the result in fraction form.	**1 ÷ 2 ÷ 2 ÷ 3** MATH **1:▸Frac** ENTER	
2. Solve using parentheses and specify that you want the result in fraction form.	(**1 ÷ 2**) **÷** (**2 ÷ 3**) MATH **1:▸Frac** ENTER	

The calculator gives two different answers, depending on how you entered the expression.

Which one is the answer for the problem $\frac{1}{2} \div \frac{2}{3}$?

Solve this problem by hand. Show all of your work here. Explain which answer from the calculator is the desired answer and why.

Additional problems—Calculate the following problems by hand. Simplify your answers. Then check your answers using the calculator. Remember to use the Order of Operation rules.

1. $-\frac{1}{3} + \frac{1}{4} =$

2. $-\frac{2}{3} \times \frac{5}{6} =$

3. $\frac{3}{5} \div \frac{5}{6} =$

4. $\frac{1}{2} - \frac{-2}{5} =$

5. $-\frac{2}{5} + \frac{1}{4} \times \frac{2}{3} =$

6. $\frac{1}{8} \times \frac{3}{16} \div \frac{1}{2} =$

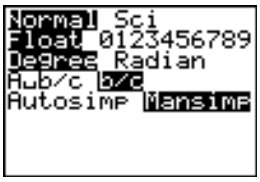
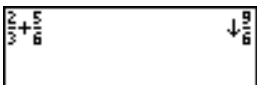
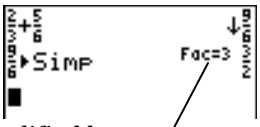
7. $-\frac{1}{6} - \frac{1}{12} + \frac{3}{4} =$

8. $-\frac{1}{2} - \frac{3}{4} \div (-3) =$

Name _____
Date _____

Try-It!™ on Your TI-73

Investigate how the calculator computes addition expressions. Solve $\frac{2}{3}+\frac{5}{6}$.

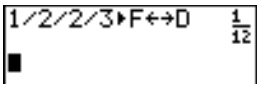
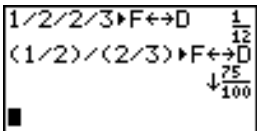
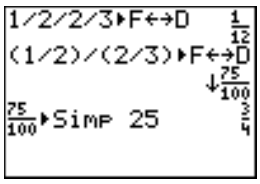
To Do This	Press	Display (TI-73 shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. Select the **b/c** and **Mansimp** mode settings. **Note**: See TIp™ 2: *Adjusting Your Calculator Settings* for more information.	MODE ▼ ▼ ▼ ▶ to highlight **b/c** ENTER ▼ ▶ to highlight **Mansimp** ENTER	
3. Calculate the result.	2nd [QUIT] **2** b/c **3** ▶ + **5** b/c **6** ENTER	
4. Simplify the fraction.	SIMP ENTER	 Simplified by a factor of 3.

Notice that the answer is in simplified form. The calculator follows the Order of Operations rules. Division is performed before addition. Solve this problem by hand. Show all of your work.

Name _____
Date _____

Try-It!™ on Your TI-73 (continued)

Investigate how the calculator computes division expressions. Solve $\frac{1}{2} \div \frac{2}{3}$.

To Do This	Press	Display (TI-73 shown)
1. Solve without parentheses and specify that you want the result in fraction form.	**1** ÷ **2** ÷ **2** ÷ **3** F↔D ENTER	
2. Solve using parentheses and specify that you want the result in fraction form.	(**1** ÷ **2**) ÷ (**2** ÷ **3**) F↔D ENTER	
3. Simplify the result by a factor of 25.	SIMP **25**	

The calculator gives two different answers, depending on how you entered the expression. Which one is the answer for the problem:

$\frac{1}{2} \div \frac{2}{3}$

Solve this problem by hand. Show all of your work here. Explain which answer from the calculator is the desired answer and why.

Additional problems—Calculate the following problems by hand. Simplify your answers. Then check your answers using the calculator. Remember to use the Order of Operation rules.

1. $-\frac{1}{3} + \frac{1}{4} =$

2. $-\frac{2}{3} \times \frac{5}{6} =$

3. $\frac{3}{5} \div \frac{5}{6} =$

4. $\frac{1}{2} - \frac{-2}{5} =$

5. $-\frac{2}{5} + \frac{1}{4} \times \frac{2}{3} =$

6. $\frac{1}{8} \times \frac{3}{16} \div \frac{1}{2} =$

7. $-\frac{1}{6} - \frac{1}{12} + \frac{3}{4} =$

8. $-\frac{1}{2} - \frac{3}{4} \div (-3) =$

Number Sense: Rational Numbers Teacher Notes

Objectives

- To review the definition of rational numbers as ratios and as terminating and repeating decimals.
- To review ordering and the reciprocal property of rational numbers.
- To review operations with rational numbers.

Math Highlights

Students review rational numbers. This includes rational numbers as ratios, terminating decimals, repeating decimals, and integers, as well as operations with fractions. In the **Observations**, students are reminded of the connection between fractions, decimals, and percents.

Common Student Errors

- Students might confuse the algorithms for addition, subtraction, multiplication, and division of fractions.
- Students may have trouble identifying whether a fraction is positive or negative. For example:

$$\frac{-1}{-3} = \frac{1}{3} \quad \text{or} \quad \frac{1}{-3} = \frac{-1}{3} = -\frac{1}{3}$$

- Students may have problems because they use short cuts to change the decimal representation of a number to a percent representation. Using short cuts does not provide an understanding of why the representations are equal. Students should understand that the quantity stays the same. Using the multiplicative identity, 1=100/100, is the key to the change in the representation. For example, students change .1875 to a percent. A shift of the decimal point gives the correct answer, but without any connection to the math they know. However, multiplying by 1 in the form 100/100 gives the same result and makes the connection to the math as well.

$$.1875 \times \frac{100}{100} = \frac{18.75}{100} = 18.75\%$$

Student Worksheet Notes with Answers

Overview

Tell students:

1. How to find the **Overview**, or tell them to review the instructions on the worksheet.
2. How to navigate the application, if they are not yet familiar with the application.
3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

Observations

The **Observations** help students understand number sense concepts relating to rational numbers. If necessary, tell students how to find the **Observations**.



Observation 1

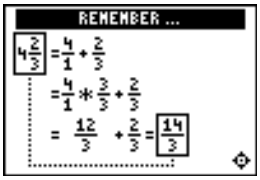
Write $4\frac{2}{3}$ as an improper fraction.

Answer: $\frac{14}{3}$

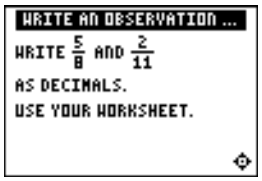
Remind students to write the answer on the worksheet and to show all of their work.

Students see the answer on the next two screens. Tell students to check the answers on the worksheet.





Observations (continued)



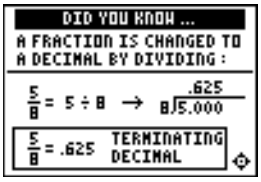
Observation 2

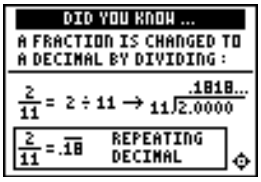
Write $\frac{5}{8}$ and $\frac{2}{11}$ as decimals.

Answer: .625 *and* $.\overline{18}$.

Remind students to write the answers on the worksheet and to show all of their work.

Students see the answers on the next two screens. Tell students to check the answers on the worksheet.







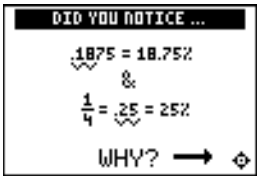
Observation 3

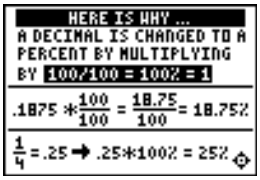
Write .1875 and $\frac{1}{4}$ as percentages.

Answer: 18.75% *and* 25%.

Remind students to write the answers on the worksheet and to show all of their work.

Students see the answers on the next two screens. Tell students to check the answers on the worksheet.





Activities



Scoring: When a row or column adds up to 1, it disappears, and the player scores 2 points.

The game automatically ends if the screen is full, or you press 〈**QUIT**〉 to stop.

Slide

Tell students to:

1. Highlight a level (bronze = least difficult; gold = most difficult), and press [ENTER] to select it.

2. Line up the fractions so they add to 1 (horizontally or vertically). As a fraction slides across the screen, press [▼] and [▲] to move it up or down. Once a fraction is in the correct row, they can press [◀] to slide it quickly to the left.

Activities (continued)



Scoring: When a row or column adds up to 1, it disappears, and the player scores 2 points.

The game automatically ends if the screen is full, or you press ⟨**QUIT**⟩ to stop.

Slide (continued)

3. Follow your instructions. For example, students can play:
 - Until the screen fills up (no time limit).
 - Until a certain amount of time has expired (highest score wins).
 - Until a certain score has been reached (first student to reach the score wins).
 - Repeatedly over a period of time (days, weeks, etc.) for tracking improvement of high scores.
4. Record the level they played.
5. Record their scores.
6. Write on the worksheet a paragraph in which they describe the **Slide** activity and the strategy for playing.



Scoring: Students get two attempts to solve each problem. They earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

They can earn up to 10 points.

Tips: Tell students that they can:

- Change the answer before they press ENTER by pressing CLEAR and re-entering the answer.
- Press ⟨**n/d**⟩ to move between the numerator and denominator.

Note: Unsimplified fractions are counted as correct.

Number Smash

Tell students to:

1. Highlight a level (bronze = least difficult; gold = most difficult), and press ENTER to select it.
2. Press ⟨**+**⟩, ⟨−⟩, ⟨∗⟩, or ⟨÷⟩ to select the operation that they want to practice.
3. Enter the missing number (press (-) for negative numbers), and press ENTER. As they play the activity, they should write each number sentence and its solution on the worksheet, showing all their work. If the missing number is a mixed number or fraction, tell them:
 - To enter a mixed number, enter the whole number, press ⟨**UNIT**⟩, and then enter the fraction.
 - To enter a fraction, press ⟨**n/d**⟩ and enter the numerator. Press ⟨**n/d**⟩ again and enter the denominator.

 If the answer is incorrect, the correct answer is displayed; press any key to resume play.
4. Record the level and operation they played.
5. Record their scores.

Try-It!™ on Your TI-83 Plus or TI-73

Review the Order of Operations rules with students, if necessary. Explain to them that the calculator uses the Order of Operations rules to simplify expressions. Discuss with them how parentheses are used.

Note: The **Try-It!** activities are repeated for each of the two calculators—the TI-83 Plus and then the TI-73. The problems are the same, but they vary due to the differences in the two calculators. The **Additional problems**, which are identical, can be performed on either calculator. They are repeated for your convenience when you copy the activities.

Tell students to do the two calculator **Try-It!** investigations.

- Investigate how the calculator computes addition expressions. Solve $\frac{2}{3}+\frac{5}{6}$.
- Investigate how the calculator computes division expressions. Solve $\frac{1}{2}\div\frac{2}{3}$.

Ask students to explain the difference in the two results in second investigation.

Although each of the two results is correct based on how the problem was entered, to make sure that the division is performed correctly, the problem must be entered as (1 / 2) / (2 / 3). The answer is 3/4, not 1/12. The calculator uses the Order of Operations rules. Operations inside parentheses are performed before operations outside parentheses.

On the TI-73, students must simplify the fraction 75/100 to get 3/4. They may either specify the factor to use, as shown, or let the calculator simplify the fraction, one factor at a time by repeatedly pressing [SIMP].

Additional problems—Make sure that students understand and use the Order of Operation rules so they can determine when to use parentheses.

1. $-\frac{1}{3}+\frac{1}{4}=-\frac{1}{12}$

2. $-\frac{2}{3}\times\frac{5}{6}=-\frac{5}{9}$

3. $\frac{3}{5}\div\frac{5}{6}=\frac{18}{25}$

4. $\frac{1}{2}-\frac{-2}{5}=\frac{9}{10}$

5. $-\frac{2}{5}+\frac{1}{4}\times\frac{2}{3}=-\frac{7}{30}$

6. $\frac{1}{8}\times\frac{3}{16}\div\frac{1}{2}=\frac{3}{64}$

7. $-\frac{1}{6}-\frac{1}{12}+\frac{3}{4}=\frac{1}{2}$

8. $-\frac{1}{2}-\frac{3}{4}\div(-3)=-\frac{1}{4}$

Name _____
Date _____

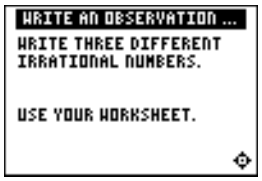
Number Sense: Real Numbers — Student Worksheet

Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

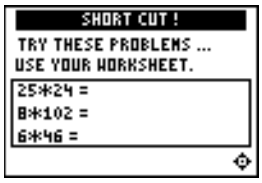
Observations

The **Observations** illustrate number sense concepts relating to real numbers. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



Observation 1

Write three different irrational numbers. Show your work.



Observation 2

Try these problems . . .

Use the real number properties to solve the following problems quickly. Show your work.

$25 \times 24 =$ _____

$8 \times 102 =$ _____

$6 \times 46 =$ _____

Name _____
Date _____

Activities

The **Activities** help you practice real number concepts. You can select from two activities—**Raining Reals** and **What Is My Property?** Follow these steps to play the activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.
2. Highlight an activity using ▲ or ▼, and press ENTER.



Scoring: Every correct placement earns 2 points.

The game automatically ends if you have answered incorrectly four times (shown in the top right corner), or you press 〈**QUIT**〉 to stop.

Raining Reals

1. Highlight a level (silver = less difficult; gold = more difficult), and press ENTER to select it.
2. As the numbers fall on your screen, quickly determine if the "raining" number is rational or irrational.
3. Press ◄ to move the number into the **RATIONAL** set, or press ► to move the number into the **IRRATIONAL** set. If the answer is incorrect, the correct answer is displayed; press any key to resume play.
4. Follow your teacher's instructions for how long to play the activity.
5. What level did you play? _____
6. What was your final score? _____
7. How many incorrect answers did you have? _____

 (Shown in top right corner of the screen.)
8. Write a paragraph describing the activity. Describe your strategy for playing.

 © 2001 Texas Instruments

Name _____
Date _____

Activities (continued)



Scoring: You get two attempts to solve each problem. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

You can earn up to 16 points.

What Is My Property?

1. Look at the equation and decide which single property, out of these six, it represents.
 - Commutative +
 - Commutative ∗
 - Associative +
 - Associative ∗
 - Distributive ∗ Over +
 - Distributive ∗ Over −
2. Scroll through the property choices with ▼ and/or ▲. To select a property, press ENTER. If the answer is incorrect, the correct answer is displayed; press any key to resume play. As you play the activity, record each equation and its property.

3. What was your score? _____

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73

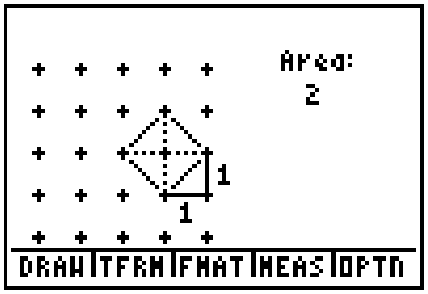
Investigate how the calculator deals with irrational numbers.

In the **Overview**, you used the Pythagorean theorem to find the length of $\sqrt{2}$. Draw a right triangle so that the hypotenuse has length $\sqrt{2}$. Pythagoras (569–475 B.C.), a great Greek mathematician, discovered irrational numbers (numbers that are not rational and therefore are not ratios). There is a proof that, for example, $\sqrt{2}$ cannot be written as a fraction.

Hint: Draw each leg with length 1 inch. The hypotenuse is $\sqrt{1^2+1^2} = \sqrt{1+1} = \sqrt{2}$

Remember that $\sqrt{2} \times \sqrt{2} = 2$. Picture this by envisioning a square whose sides measure $\sqrt{2}$ units. You created this length in your picture above.

Look at the square whose side has a length of $\sqrt{2}$ on the Geoboard screen below. Can you see that the area is $\sqrt{2} \times \sqrt{2} = 2$ square units? Count it up! Shade in the area on the screen shown.

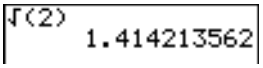
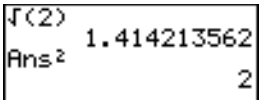


From the TI-73 Geoboard application

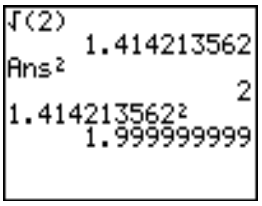
Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Find the calculator decimal approximation for $\sqrt{2}$.

To Do This	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. Select the **Float** setting from the mode screen. **Notes**: See TIp™ 2: *Adjusting Your Calculator Settings* for details. The TI-83 Plus mode screen varies slightly from the TI-73.	MODE ▼ until **Float** is highlighted ENTER	
3. Return to the Home screen.	2nd [QUIT]	
4. Calculate the decimal approximation for $\sqrt{2}$.	2nd [√] **2**) ENTER	
5. Square your result. **Note**: **Ans** = previous answer. The calculator remembers that you entered √**(2)**.	x^2 ENTER	

Is $\sqrt{2}$ equal to the decimal 1.414213562? It looks like the calculator says this is true. Calculate 1.414213562^2 to see.

6. Calculate the square of 1.414213562.	**1** . **4 1 4 2 1 3 5 6 2** x^2 ENTER	

The answer shows 1.999999999, but you know you should get the answer 2.

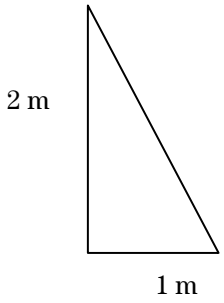
Be careful! When you use your calculator, you have to know your math. The calculator can do amazing math, **but** it only shows you an approximation for many answers. You have to understand the problem before you use the calculator. It is up to **you** to determine if calculator answers are reasonable and how you will use them.

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Word Problem: Missy's Garden

Missy wants to build a small fence around a garden in her backyard. The garden is in the shape of a right triangle. One leg is 2 meters and the other leg is 1 meter. The store sells fencing in tenths of a meter.



1. What is the exact perimeter of Missy's garden? Show all your work.

Math Hint: Use the Pythagorean theorem to find the length of the third side of the garden, and then find the perimeter of the garden. (See the **Real Numbers Overview** on the calculator.)

2. What length of fencing should Missy buy if the store only sells the fencing in tenths of a meter? Use the calculator. Show all your work.

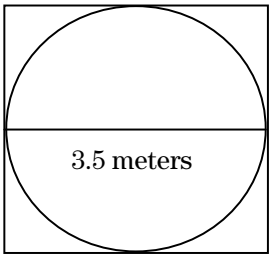
Calculator Hint: After you calculate the approximate answer on your calculator, try setting MODE so that **Float=1**.
See TIp™ 2: *Adjusting Your Calculator Settings* for details. This will give you one decimal place or tenths. Observe how the calculator displays the results!

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Word Problem: Jose and Maria's Backyard Pool

Jose and Maria have a circular pool in their backyard. Their parents would like to make a cover for the pool. They bought a square piece of material whose sides are the same length as the diameter of the pool. The diameter of the pool is 3.5 meters.



1. How much material will they have left over? Find the exact and approximate answers. Use the calculator. Show all your work. (See Hints below.)

2. Exact answer: _____

3. Approximate answer (to 3 decimal places): _____

Calculator Hints:

- Use **Float = 3** on your calculator to display 3 decimal places.
- Press [2nd] [π] to find the calculator's approximation for π.

Math Hints:

- Area of a square: $A = s^2$, where s is the length of the sides of the square.
- Area of a circle: $A = \pi r^2$, where r is the radius of the circle (diameter = 2r).

Number Sense: Real Numbers Teacher Notes

Objectives

- To illustrate the real number system in a Venn diagram.
- To identify real numbers as rational numbers ∪ irrational numbers.
- To review writing rational numbers as terminating or repeating decimals.
- To review writing irrational numbers as nonterminating, nonrepeating decimals.
- To show physical representations of the irrational numbers, $\sqrt{2}$ and π, and to review the Pythagorean theorem and the formula for finding the circumference of a circle.
- To state the real number system properties—commutative, associative, and distributive—as well as the identity and inverse properties.

Math Highlights

This section starts with the building of the Venn diagram of the real number system. Definitions of rational and irrational numbers are given. Two examples of irrational numbers, $\sqrt{2}$ and π, are developed. $\sqrt{2}$ is shown as the length of the hypotenuse of a right triangle with legs of 1 unit. π is shown as the circumference divided by the diameter for any circle. The statements of the properties of the real numbers follow.

Common Student Errors

- Many students may not have developed a solid understanding of number sets. Remind them that using rational and irrational numbers, they can name every location on a number line. Later in their studies of mathematics, this will be referred to as the Completeness Property of Real Numbers, which was an important discovery in mathematics. Later, they will also extend the real numbers to the complex numbers, $a + b\sqrt{-1} = a + bi$, which are numbers used, for example, in the study of the relationship between electricity and magnetism.
- Students probably have used 22/7 or 3.14 as an approximation of π. They may think that these values are exactly π, but they are not equal to π. This provides an opportunity to talk about approximations to several decimal places in real problems. The worksheet problems give students an opportunity to find exact and approximate answers. There are wonderful web sites that show π to millions of places. Mathematicians are still searching for more place values. This study of π requires the use of computers to assist the search.
- Some students may not be aware that the ratio of the circumference of a circle C divided by the diameter d is π. $C/d = \pi$. This may be confusing because they have been told that π is irrational and is **not** a ratio. Yet π came from a ratio of circumference to diameter. It turns out that either C or d is also irrational. The mathematics to prove this is not given at this level; therefore, students have to accept this without much explanation. This is a deep discussion that will not be of interest to some students, but other students may find it fascinating.

Student Worksheet Notes with Answers

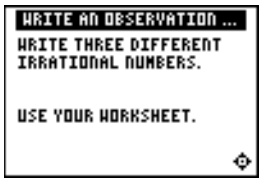
Overview

Tell students:

1. How to find the **Overview**, or tell them to review the instructions on the worksheet.
2. How to navigate the application, if they are not yet familiar with the application.
3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

Observations

The **Observations** help students understand number sense concepts relating to real numbers. Tell students how to find the **Observations**.

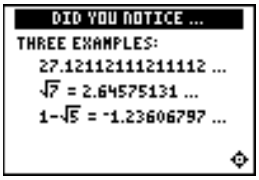


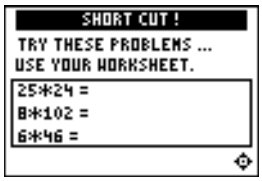
Students see this screen with three possible answers.

Observation 1

Write three different irrational numbers. Students show their work.

Answers will vary.





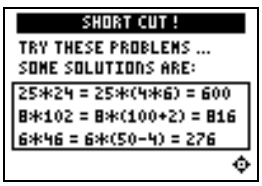
Students should show that they know how to use the properties of the real number computations as shortcuts without the calculator.

Observation 2

Try these problems . . .
Students use the real number properties to solve the problems, showing their work.

- *associative* ∗ *property*:
 $25 * 24 = 25 * (4 * 6) = (25 * 4) * 6 = 100 * 6 = 600$
- *distributive* ∗ *over* + *property*:
 $8 * 102 = 8 * (100 + 2) = (8 * 100) + (8 * 2) = 800 + 16 = 816$
- *distributive* ∗ *over* − *property*:
 $6 * 46 = 6 * (50 - 4) = (6 * 50) - (6 * 4) = 300 - 24 = 276$

Students see the answers on the next screen.



Activities



Scoring: Every correct placement earns 2 points. When students give an incorrect answer, the correct answer displays.

The game automatically ends when they have answered incorrectly four times (shown in the top right corner), or they press 〈**QUIT**〉 to stop.

Raining Reals

Tell students to:

1. Highlight a level (silver = less difficult; gold = more difficult), and press ENTER to select it.
2. Determine if the "raining" number is rational or irrational.
3. Press ◄ to move the number into the **RATIONAL** set, or press ► to move the number into the **IRRATIONAL** set. If the answer is incorrect, the correct answer is displayed; press any key to resume play.
4. Follow your instructions. For example, students can play:
 - until they have answered incorrectly four times (no time limit)
 - until a certain amount of time has expired (high score wins)
 - until a certain score has been reached (first student to reach the score with the fewest misses wins)
 - over a period of time (days, weeks, etc.) for tracking improvement of high scores
5. Record the level they played.
6. Record their final scores.
7. Record how many incorrect answers they had.

 (Shown in top right corner of the screen.)
8. Write their strategy for playing the game.



Scoring: Students get two attempts to answer. They earn 2 points for a correct answer, 1 point for a correct answer on the second try.

They can earn up to 16 points.

What Is My Property?

Tell students to:

1. Look at the equation and decide which one property, out of these six, it represents:
 - Commutative +
 - Commutative ∗
 - Associative +
 - Associative ∗
 - Distributive ∗ Over +
 - Distributive ∗ Over −
2. Scroll through the choices with ▼ and/or ▲ and press ENTER to select the correct property. If the answer is incorrect, the correct answer is displayed; press any key to resume play. As they play the activity, record each equation and its property.
3. Record their scores.

Try-It!™ on Your TI-73 or TI-83 Plus

Tell students to:

- Use the Pythagorean theorem to draw a triangle whose two legs = 1 unit and whose hypotenuse = $\sqrt{2}$ units.
- Shade in the area on the Geoboard screen on the worksheets.
- Go through the keystroke example to:
 - Find the calculator decimal approximation for $\sqrt{2}$.
 - Understand how the calculator approximates numbers.
 - Understand that they must be conscientious about the mathematics involved.

Word Problem: Missy's Garden

Remind students to:

- Use the Pythagorean theorem to find the third side of the garden and then the perimeter.
- Set the decimal mode notation ([MODE]) to **Float** and then to **1** (answer rounded to tenths), so they can see how the calculator displays answers.

1. *Exact perimeter: 1 + 2 + $\sqrt{5}$ meters*
2. *Length of fencing rounded to tenths: 5.2 meters*

Note: The number rounds down. This is mathematically correct, but impractical in the real world, where Missy would need to purchase 5.3 meters in order to fence the garden. You may want to discuss meaningful interpretation of word problems with the students.

Word Problem: Jose and Maria's Backyard Pool

If necessary, review the formulas for area of a square and area of a circle. They are shown on the worksheet.

Covering material left over:

1. *Exact: Area of square—area of circle* = $(3.5)^2 - \pi(3.5/2)^2 = 12.25 - 3.0625\,\pi$ *square meters*
2. *Approximate:* 2.629 *square meters* (3 *decimal places; use* **Float=3**)

Name _____
Date _____

Linear Equations: Using Graphs & Tables — Student Worksheet

Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

Observations

The **Observations** illustrate linear equation concepts relating to graphs and tables. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



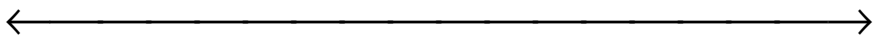
Observation 1

Using a table, find the solution of **$-x-6 = -3.5$**.

First, find the solution by hand, making a table with at least five x and y values. You can start with any x value you want. Show your work.

x	y

Next, graph your solution on a number line. Be sure to label all points on the number line.



Name _____
Date _____

Activities

The **Activities** help you practice graphs and tables. You can select from two activities—**Beam Dale Up** or **Worksheet Activity**. Follow these steps to play the activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.
2. Highlight an activity using ▲ or ▼, and press ENTER.



Scoring: You get two attempts to solve each problem. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

You can earn up to 10 points.

Beam Dale Up

1. Look at the problem on the space ship and determine how to solve the equation for **x** from the four choices given. The values are ordered as they are on a number line.
2. Press ◄ and ► to move Dale the Martian over the correct **x** value, and then press ENTER. If the **x** value you pick is correct, Dale is beamed up to his ship! If the answer is incorrect on the second attempt, the correct answer is displayed; press any key to resume play. As you play the activity, solve each equation in the space below. Show all steps and work.

3. What was your score? _____



Note: Press ◄ or ► to leave this screen.

Worksheet Activity

1. Look at the table of values of equations **Y_1=2X+4.5** and **Y_2=7**.

X	Y_1	Y_2
0	4.5	7
.5	5.5	7
1	6.5	7
1.5	7.5	7
2	8.5	7
2.5	9.5	7
3	10.5	7

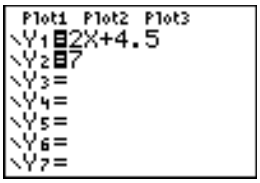
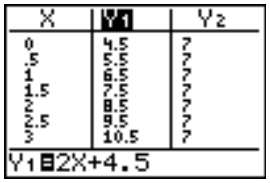
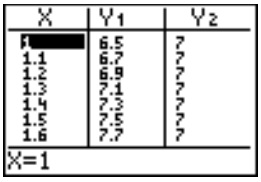
Y_1■2X+4.5

2. When is **2X+4.5=7** (or, when is **Y_1=Y_2**)? Look at the table carefully. The solution is between which two **X** values?

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73

Use the table feature on your calculator to search for the solution (when **Y1=Y2**).

To Do This	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. First, enter **2X+4.5** as **Y1** and **7** as **Y2** in the Y= editor. **Note:** See TIp™ 3: *Graphing a Function in the Standard Window* for more information. **Note**: On the TI-73, use [x] rather than [X,T,Θ,n].	Y= CLEAR **2** [X,T,Θ,n] + **4** . **5** ▼ CLEAR **7**	
3. Change the table settings to those used in the Worksheet Activity.	2nd [TBLSET] **0** ▼ **.5** ▼ ENTER ▼ ENTER	
4. Display the table.	2nd [TABLE]	
5. Change the table settings to focus on the range you found in the Worksheet Activity. Begin the table at the lower value and make the increments smaller.	2nd [TBLSET] **1** ▼ **.1**	
6. Display the table with the new settings.	2nd [TABLE]	

7. The table still does not display the exact solution. What table settings would you choose in order to display the exact solution?

 TblStart= _____

 ΔTbl= _____

8. What is the solution (when is **Y1=Y2**)? _____

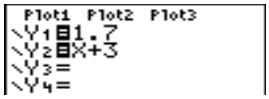
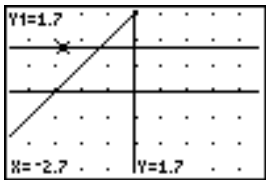
9. How do you know this is the solution? _____

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Solution Search Using X-Y Graphs: Find the solution for the equation **X+3=1.7**. First, use your number sense to estimate the solution for **X+3=1.7**. Record your estimate here. _____

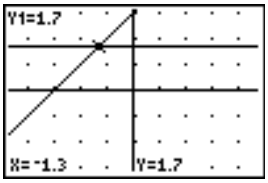
Use the table feature on your calculator to search for the solution (when **Y_1=Y_2**).

To Do This	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. Set the window format as shown. **Note:** See TIp™ 2: *Adjusting Your Calculator Settings* for more information. Screens are shown for the TI-83 Plus. There are slight differences on the TI-73.	2nd [FORMAT]	
3. Enter both sides of the equation into the Y= editor as shown. **Note:** See TIp™ 3: *Graphing a Function in the Standard Window* for more information. **Note**: On the TI-73, use x rather than X,T,Θ,n.	Y= CLEAR **1** . **7** ▼ CLEAR X,T,Θ,n + **3**	
4. Select **ZDecimal** to set the viewing window and automatically graph the functions.	TI-83 Plus: ZOOM **4:ZDecimal** TI-73: ZOOM **8:ZDecimal**	
5. Trace **Y_1=1.7**. 6. Trace **Y_2=X+3**. **Note**: The function displays in the upper left corner of the screen; the **X** and **Y** values are displayed on the bottom of the screen.	TRACE ◄ or ► to trace a function ▲ and ▼ to move between functions	

7. Find where **X+3=1.7**. What is the solution? _____

8. How do you know? _____

9. Did you notice that the value of **X+3** is **1.7** when **X=-1.3**?



Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Solution Search: Write the solution and explain how you found the solution using graphs and tables for each of the problems below.

For each problem:

- Before you start, estimate the solution so you have an idea of where the solution is located.
- Search for the solution of the equation on the calculator using graphs and table.

 Note: See TIp™ 4: *Creating a Table* for additional help with the calculator.
- Remember to change your viewing window or your table setting to do your search.

 Note: See TIp™ 5*: Adjusting the Viewing Window* for additional help with the calculator.
- Explain how you found the solution.

Calculator Fact: The calculator only uses the variables **X** and **Y** for graphs and tables. If an equation uses letters other than **X**, you will have to enter the letter for the unknown variable as **X** in the calculator in order to make the graphs and tables for your solution search.

1. $p + 3 = 1$

2. $3x - 2 = 1.6$

3. $\frac{1}{2}x + \frac{5}{8} = \frac{7}{8}$

4. $4 + 0.5C = 7$

Calculator Hint: Use **ZStandard** to change the graph window so that: $-10 \le X \le 10$ and $-10 \le Y \le 10$.

Linear Equations: Using Graphs & Tables — Teacher Notes

Objectives

- To illustrate how to locate the real number solution of a linear equation using tables.
- To illustrate how to locate the real number solution of a linear equation using a graphical method on a Cartesian (x-y) graph.

Math Highlights

In the table of values method, students see a table of values for the left and right side of the equation. They see that the x value, which makes the two sides of the equation equal, is the solution. They also see that they may need to refine the table of values to search for the solution.

In the x-y graphical method, students graph both sides of the equation and find the intersection of the lines. If students have not graphed lines, they can first make a table of values and then plot the points to graph the lines. The x coordinate of the intersection of the lines is the solution.

Common Student Errors

- Using graphs and tables can mislead a student to think that they can always find the exact solution using these methods. Although they often will find exact solutions using these methods, using algebra will give exact answers for these equations. Have students try to search for the solution to $x + \sqrt{2} = \sqrt{7}$. The exact answer is $x = \sqrt{7} - \sqrt{2} = 1.2315377\ldots$
- At times, introducing the algebraic solution of equations gives students just the mechanics of doing a problem. Algebraic methods alone usually do not invite the student to reason out the solution using number sense. The graphs and tables method gives students the opportunity to see the values of each side of the equation so they can see when the right side and left side of the equation are equal.

 Visual learners benefit by seeing the numbers and graphs first, and then by using these as the tool to find the solution.
- Some students are able to see the solution to an equation using their number sense and may have difficulty taking the time to show their work. This may also be an issue in Chapter 2: Linear Equations, Section 2: Using Algebra. Encourage the use of written mathematics and drawing graphs and tables as a communication tool. Have students look in newspapers for graphs and tables of information to show real examples for the need for this communication skill.

Student Worksheet Notes with Answers

Overview

Tell students:

1. How to find the **Overview** or tell them to review the instructions on the worksheet.
2. How to navigate the application, if they are not yet familiar with the application.
3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

Observations

The **Observations** help students understand linear equation concepts relating to graphs and tables.

If necessary, tell students how to find the **Observations** section for this section.



Observation 1

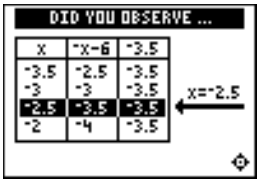
Using a table, find the solution of **-x–6 = -3.5**.

First, find the solution by hand, making a table with at least five **x** and **y** values. The students can start with any **x** value they want. Students show their work.

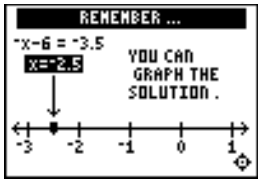
Next, they graph the solution on a number line. Remind them to label all points on the number line.

Students make a table by hand on the worksheet to search for the solution of **-x** *– 6 = -3.5. Then they transfer these* **x** *and* **y** *values to a number line. Look for correct labeling.*

Students see the table and graph screens as they finish viewing the observation.



x	-x-6	-3.5
-3.5	-2.5	-3.5
-3	-3	-3.5
-2.5	-3.5	-3.5
-2	-4	-3.5



Activities



Scoring: Students get two attempts to solve each problem. They earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

Students can earn up to 10 points.

Beam Dale Up

Tell students to:

1. Look at the problem on the space ship and determine how to solve the equation for **x** from the four choices given. The values are ordered as they are on a number line.

2. Press ◄ and ► to move Dale the Martian over the correct **x** value, and then press ENTER. If the **x** value they pick is correct, Dale is beamed up to his ship! As they play the activity, students record the solution to each equation, showing all steps and work. If the answer is incorrect on the second attempt, the correct answer is displayed; press any key to resume play.

3. Record their scores.



Note: Press ◄ or ► to leave this screen.

Worksheet Activity

Tell students to:

1. Look at the table of values of the expressions, **Y_1=2X+4.5** and **Y_2=7**.

2. Answer the questions: When is **2X+4.5=7** (or, when is **Y_1=Y_2**)? The solution is between which two **X** values?

The solution for **2X+4.5=7** *is found between* **1** *and* **1.5**.

Students will continue to search for the solution in the Try-It! section.

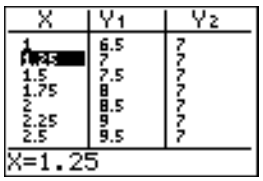
Try-It!™ on Your TI-83 Plus or TI-73

Tell students to:

- Follow the steps exactly on the calculator, using the table feature to find the solution. Example screen pictures are displayed on the worksheet for students to compare with the calculator screen. This keystroke exercise lets students define **Y1=2X+4.5 and Y2=7**.
- Determine what the table settings should be for an exact solution and record them on their worksheet.

 Answer: **ΔTbl=0.25** *and* **TblStart=1**.





- Find the solution and record it. *Answer:* **Y1=Y2** *when* **X=1.25**.

Solution Search Using X-Y Graphs: Find the solution for the equation **X+3=1.7**.

Tell students to:

- Estimate the solution and record it on their worksheets.
- Follow the steps exactly on the calculator. Example screen pictures are displayed on the worksheet for students to compare with the calculator screen. This keystroke exercise lets students find the solution where **X+3=1.7**.
- Record the solution and explain their answers on the worksheet after step 6.
 Answers will vary. Student estimates using number sense should be close to the answer **-1.3**. *They see that the two lines intersect at* **x=-1.3**.

Note: See the *TI-83 Plus Guidebook*, for information on the TI-83 Plus automatic feature "Intersection," which is not covered in this section. This feature is not on the TI-73.

Solution Search: Students write the solution and explain how they found the solution using graphs and tables for each of the problems below.

Tell students to:

- Review how to use the graphing features of the calculator to search for a solution.
- Find the intersection of the lines by tracing the graph. Remind students that the viewing window must be set appropriately to find the intersection, and finding the exact solution is not guaranteed; they must combine the two methods to find the solutions.
- Use number sense to complete the search.

1. $p + 3 = 1$ *when* $p = -2$

2. $3x - 2 = 1.6$ *when* $x = 1.2$

3. $\frac{1}{2}x + \frac{5}{8} = \frac{7}{8}$ *when* $x = \frac{1}{2}$

4. $4 + 0.5C = 7$ *when* $C = 6$

Name _____
Date _____

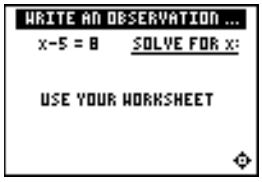
Linear Equations: Using Algebra — Student Worksheet

Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

Observations

The **Observations** illustrate linear equation concepts relating to algebra. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



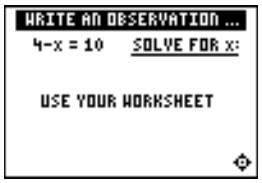
Observation 1

x − 5 = 8 Solve for **x**. Show all of your work below.



Observation 2

$\frac{3}{2}x = 9$ Solve for **x**. Show all of your work below.



Observation 3

4 − x = 10 Solve for **x**. Show all of your work below.

Name _____
Date _____

Activities

The **Activities** help you practice algebraic concepts. You can select from three activities—**Solve It!**, **Beam Dale Up**, and **Free Fall**. Follow these steps to play an activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.
2. Highlight an activity using ▲ or ▼, and press ENTER.



Scoring: You get two attempts to pick the correct step or steps. You get 2 points for a correct choice on the first try, and 1 point for a correct choice on the second try. You get an additional 2 points for the correct solution.

The total number of points available varies.

Solve It!

1. Highlight a level (silver = less difficult; gold = more difficult), and press ENTER to select it.
2. Look at the algebraic expression at the top of the screen and decide what step to take to solve the equation for **x**.
3. Press ▼ or ▲ to cycle through steps to choose from, and then press ENTER to select the correct step (some problems require two steps). If your second choice is incorrect, the correct step is displayed; press any key to continue play. As you play the activity, write the equations, the steps required to solve them, and the solutions to the equations.

4. What level did you play? _____
5. What was your score? _____ out of _____

 © 2001 Texas Instruments

Name _____
Date _____

Activities (continued)



Scoring: You get two attempts to solve each problem. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

You can earn up to 10 points.

Beam Dale Up

1. Highlight a level (silver = less difficult; gold = more difficult), and press ENTER to select it.

2. Look at the problem on the space ship and determine how to solve the equation for **x** from the four choices given.

3. Press ◄ and ► to move Dale the Martian over the correct **x** value, and then press ENTER. If the **x** value you pick is correct, Dale is beamed up to his ship! If the answer is incorrect on the second attempt, the correct answer is displayed; press any key to resume play. As you play the activity, solve each equation in the space below. Show all steps and work.

4. What level did you play? _____

5. What was your score? _____

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Name _____
Date _____

Activities (continued)



Scoring: Points are based on how quickly you solve each equation.

The game automatically ends if four missed equations stack up, or you press ⟨**QUIT**⟩ to stop.

Free Fall

1. Highlight a level (silver = less difficult; gold = more difficult), and press [ENTER] to select it.

2. When you are ready to start, press any key.

3. Watch the equation as it falls, and quickly solve for **x**. Enter the solution (press [(-)] for negative numbers), and press [ENTER] before the equation hits bottom. If you give an incorrect answer, the correct answer is displayed; press any key to resume play. The incorrect equation stacks up at the bottom of the screen, giving you less time to solve the next equation.

4. Follow your teacher's instructions for how long to play the activity.

5. What level did you play? _____

6. What was your score? _____

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Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73

Can your calculator check your work? Is **X=2** the solution to the equation **X+3.1=5.5**?

To Do This	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen. From the Home screen, the calculator can tell you if a sentence is TRUE or FALSE (**1**=TRUE and **0**=FALSE).	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. First, check for the value currently stored in **X**. **Note**: On the TI-73, use x rather than X,T,Θ,n.	X,T,Θ,n ENTER	X -3.2
3. What is the value of **X** stored in your calculator? _____ Check around the class. Most likely, there are many different values stored to **X**.		
4. Next, find out: Is **X+3.1=5.5** true or false when **X=2**? When you tell the calculator that **X=2**, this is called storing a value in **X**. **Note**: On the TI-73, use x rather than X,T,Θ,n.	**2** STO▶ X,T,Θ,n ENTER	2→X 2
5. Enter the expression **X+3.1=5.5.** This takes three steps. a. Enter the first part of the expression: **X+3.1**. **Note**: On the TI-73, use x rather than X,T,Θ,n.	X,T,Θ,n + **3** . **1**	2→X 2 X+3.1
b. Enter the equal sign (**=**) for the test.	2nd [CATALOG] ▲ until **=** is highlighted ENTER	CATALOG ▶= ≠ < >
c. Now, complete the sentence and see the result. Since the result is **0** (**1**=TRUE and **0**=FALSE), the sentence **X+3.1=5.5** is false when **X=2**.	**5** . **5** ENTER	2→X 2 X+3.1=5.5 0

6. Test another point. Try **X=3**. Is the sentence true or false? What value do you think makes the sentence true?

 Hint: You do not have to type in the expressions again.

 - On the TI-73, press ▲ to highlight previous entries, and press ENTER to paste an entry on the current line. You can edit the line and use it again.
 - On the TI-83 Plus: 2nd [ENTRY] displays previous entries. When you get to the one you want, you can edit the line and use it again.

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Additional Problems—Solve the following equations by hand. Show all of your work. Then test your solution using the calculator as shown in the Try-It! example on the previous page.

1. $x - (-4) = 12$

2. $\frac{3}{4}W - \frac{1}{4} = -\frac{5}{8}$

3. $5.25 + P = -3.5$

Hint: To find **=** and other relations:

- **TI-83 Plus:** Press [2nd] [TEST], and then select the relation you want.
- **TI-73:** Press [2nd] [TEXT] to enter the text editor, select the relation you want, press [ENTER], select **Done**, and press [ENTER].

Linear Equations: Using Algebra Teacher Notes

Objectives

- To review one-step and two-step linear equations.
- To review the idea of isolating the variable, balancing equations and checking solutions.
- To review the properties of equality.

Math Highlights

This section opens with an explanation of the idea of balancing equations using a pan balance. The properties of equality are displayed. Then, examples of solving linear equations of the forms $x + a = b$, $ax = b$, and $ax + b = c$ are shown. These examples start with word problems and are then modeled with linear equations, solved, and the solution is checked.

Common Student Errors

- Students may have a hard time deciding which steps to follow to solve an equation. In particular, if they are given an equation in the form $x + a = b$, they may choose the wrong step to take if the equation is given as $a + x = b$. Students might make sign errors as they add or subtract from both sides of the equation.
- Students should connect the idea of a zero model from working with integers; for example, they should connect $7 + {-7} = 0$ with the concept of an additive inverse. They use the additive inverse to create the zero model. The term zero model is not discussed.
- Students should notice that they are using the multiplicative inverse to isolate the variable when they multiply or divide both sides of equations.
- Although this section deals with the mechanical way of finding the solution set, students should be reminded that they should check to see if the solution is reasonable. They need to keep using number sense.
- Many students are able to see the answer using number sense without the written work. Learning how to write mathematics correctly is part of the communication skill and needs to be encouraged. This can cause frustration for students who find the problems easy to solve "in their heads."

Student Worksheet Notes with Answers

Overview

Tell students:

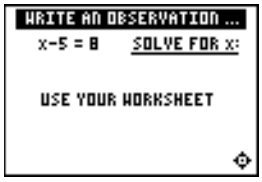
1. How to find the **Overview**, or tell them to review the instructions on the worksheet.

2. How to navigate the application, if they are not yet familiar with the application.

3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

Observations

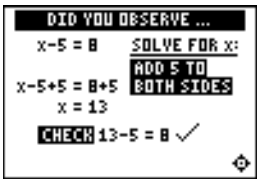
The **Observations** help students understand algebraic concepts relating to linear equations. If necessary, tell students how to find the **Observations**.

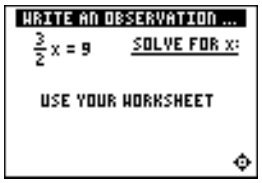


Students solve for **x**. The answer is displayed on this screen.

Observation 1

x–5 = 8 Solve for **x**. Students show all their work.

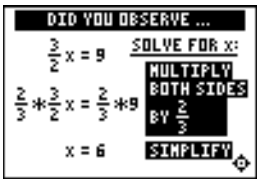


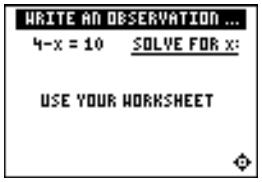


Students solve for **x**. The answer is displayed on this screen.

Observation 2

$\frac{3}{2}x = 9$ Solve for **x**. Students show all their work.

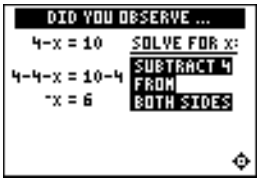


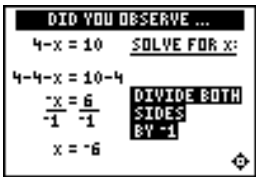


Students solve for **x**. The answer is displayed on these screens.

Observation 3

4–x = 10 Solve for **x**. Students show all their work.





Activities



Scoring: Students get two attempts to pick the correct step or steps. They get 2 points for a correct choice on the first try, and 1 point for a correct choice on the second try. They get an additional 2 points for the correct solution.

The total number of points available varies.

Solve It!

Tell students to:

1. Highlight a level (silver = less difficult; gold = more difficult), and press ENTER to select it.
2. Look at the algebraic expression at the top of the screen and decide what must be done to solve the equation for **x**. Students must select from the choices offered; this activity presents only one sequence of steps (to first isolate **x** and then change the coefficient of **x** to 1), although other sequences may be correct.
3. Press ▼ or ▲ to cycle through steps to choose from, and then press ENTER to select the correct step (some problems require two steps). If the second choice is incorrect, the correct step is displayed. They must press a key to continue play. As they play the activity, students should write the equations, the steps required to solve them, and the solutions.
4. Record the level they played.
5. Record their scores.



Scoring: Students get two attempts to solve each problem. They earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

Students can earn up to 10 points.

Beam Dale Up

Tell students to:

1. Highlight a level (silver = less difficult; gold = more difficult), and press ENTER to select it.
2. Look at the problem on the space ship and determine how to solve the equation for **x** from the four choices given.
3. Press ◄ and ► to move Dale the Martian over the correct **x** value, and then press ENTER. If the **x** value they pick is correct, Dale is beamed up to his ship! As they play the activity, students record the solution to each equation, showing all steps and work. If the answer is incorrect on the second attempt, the correct answer is displayed; press any key to resume play.
4. Record the level they played.
5. Record their scores.

Activities (continued)



Scoring: Points are based on how quickly students solve each equation.

Unless you specify point or time limits for this activity, students can play the activity when four missed equations stack up, or they press 〈**QUIT**〉 to stop. There is no time limit.

Free Fall

Tell students to:

1. Highlight a level (silver = less difficult; gold = more difficult), and press [ENTER] to select it.
2. When they are ready to start, press any key.
3. Watch the equation as it falls, and quickly solve for **x**. Enter the solution (press [(-)] for negative numbers), and press [ENTER] before the equation hits bottom. If students give an incorrect answer, the correct answer is displayed; press any key to resume play. The incorrect equation stacks up at the bottom of the screen, giving them less time to solve the next equation.
4. Follow your instructions. For example, students can play:
 - Until they have answered incorrectly four times (no time limit).
 - Until a certain amount of time has expired (highest score with the fewest misses wins).
 - Until a certain score has been reached (first student to reach the score with the fewest misses wins).
 - Repeatedly over a period of time (days, weeks, etc.) for tracking improvement of high scores.
5. Record the level they played.
6. Record their scores.

Try-It!™ on Your TI-83 Plus or TI-73

Tell students to:

- Solve the following equations by hand and show all of their work.
- Test their solutions using the calculator as shown in the Try-It! example on the previous page.

1. $x - (-4) = 12$ *when* $x = 8$

2. $\frac{3}{4}W - \frac{1}{4} = -\frac{5}{8}$ *when* $W = -\frac{1}{2}$

3. $5.25 + P = -3.5$ *when* $P = -8.75$

Name _____
Date _____

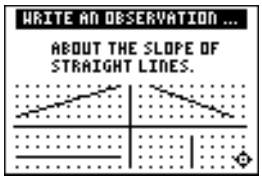
Linear Functions: Slope with Grid — Student Worksheet

Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

Observations

The **Observations** illustrate the slope of a straight line. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



Observation 1

What do you notice about the slope of straight lines? Write your thoughts.

Activities

The **Activities** help you practice determining the slope of a line using a grid. You can select from two activities—**Screen Cross** or **Linked Calculators Screen Cross**. Follow these steps to play the activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.
2. Highlight an activity using ▲ or ▼, and press ENTER.

Name _____
Date _____

Activities (continued)



Scoring: You get two attempts to solve each problem. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

You can earn up to 10 points.

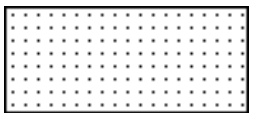
Screen Cross

1. Read the directions on the screen, and then press any key to continue.

 Note: Repeat steps 2 and 3 for line segments 2 through 5.

2. Calculate the slope between the two points. Record your work below.

3. Press ▲ or ▼ to view the choices for the slope (**UNDEF** = undefined slope). When you think the correct slope is displayed, press ENTER.



 segment 1: _____

 segment 2: _____

 segment 3: _____

 segment 4: _____

 segment 5: _____

4. What was your score? _____



Scoring: There are no points awarded in the linked version. You must answer correctly before the next line segment is shown.

The player who reaches the right side of the grid first wins.

Linked Calculators Screen Cross

Play Screen Cross against another student. Race another student across the screen by calculating the slopes more quickly than your opponent.

1. Connect two similar calculators using a unit-to-unit cable.

2. Use the grid to help determine the slope of the line segment as quickly as possible.

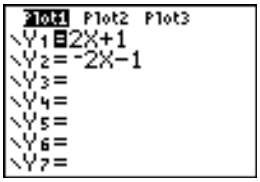
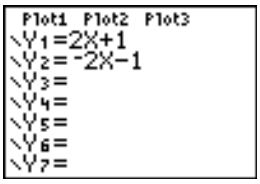
3. Select the slope as you did in Screen Cross.

4. Who won? _____

Name _____
Date _____

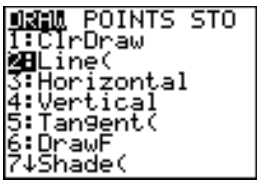
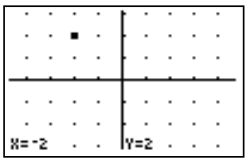
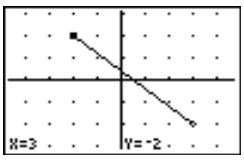
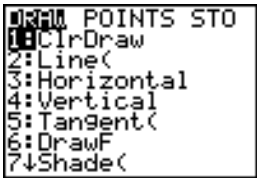
Try-It!™ on Your TI-83 Plus or TI-73

Draw a line segment with endpoints at (-2,2) and (3,-2). Use the **Line(** command, which draws line segments on the graph screen.

To Do This	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. Check to see if any functions or statistical plots are turned on.	Y=	
3. Turn off statistical plots or functions, if necessary. **Note:** See TIp™ 8: *Creating a Statistical Plot* for more information.	◄, ►, ▼, or ▲ ENTER to deselect	
4. Display the window format screen.	2nd [FORMAT]	
5. Select **GridOn**.	TI-83 Plus: ▼ ▼ ► ENTER TI-73: ▼ ► ENTER	
6. Display the **ZOOM** menu. These settings set the viewing window automatically. **Note:** For more information, see TIp 5: *Adjusting the Viewing Window.*	ZOOM	
7. Select **ZDecimal**. **Note**: This also displays the graph screen automatically.	TI-83 Plus: **4:ZDecimal** TI-73: **8:ZDecimal**	

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

To Do This	Press	Display (TI-83 Plus shown)
8. Select the **DRAW** menu.	TI-83 Plus: 2nd [DRAW] TI-73: DRAW	
9. Select the **Line(** command, which draws line segments on the graph screen.	**2:Line(**	
10. Move the cursor to (-2,2). 11. Set the endpoint (-2,2).	◄, ►, ▼, or ▲ ENTER	
12. Move the cursor to (3,-2). 13. Set the other endpoint (3,-2). The line segment is drawn.	◄, ►, ▼, or ▲ ENTER	
14. Clear your drawing with **ClrDraw**, if desired.	TI-83 Plus: 2nd [DRAW] **1:ClrDraw** TI-73: DRAW **1:ClrDraw**	

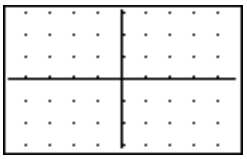
Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

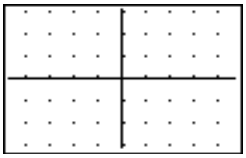
Draw the Slopes!

1. On your calculator use **Line** to draw segments that have the following slopes (m), and then copy the graph onto the screens below.

 a. $m = 1/2$

 b. $m = 2/4$

 c. $m = 3/2$

 d. $m = -2/3$

2. Compare your graphs with others in your class. Do you all get the same graph? If not, why?

3. Compare the four segments drawn. Record your observations.

Linear Functions: Slope with Grid — Teacher Notes

Objectives

- To impose a grid on a line to quantify the steepness of a line.
- To introduce slope as the ratio of the vertical change divided by the horizontal change.
- To illustrate the slope characteristics of lines as positive, zero, negative, or undefined (no slope).
- To associate the terms with the appropriate graph of a line: increasing, horizontal, decreasing, or vertical.
- To observe that the slope of a straight line is a constant.

Math Highlights

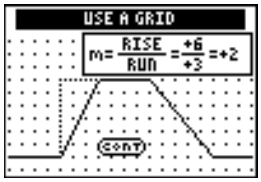
This section defines slope as the steepness of a line. It begins with a bike riding along a piecewise linear path. Students see the definition of slope as a ratio:

$$\text{Slope} = m = \frac{\text{vertical change}}{\text{horizontal change}} = \frac{\text{rise}}{\text{run}}$$

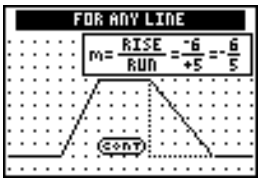
A grid is imposed on the bike path to help illustrate how students can quantify the slope of each line segment. Next, lines with positive, zero, negative, and no slope are illustrated.

Common Student Errors

- Students may have difficulties counting the *spaces* between grid points; therefore, they may count the grid points instead of the spaces. For example, students who count grid points may think that the slope shown on the screen below is 7/4 instead of 6/3. Using a Geoboard or grid paper, redraw the line segment to help these students count the distance between the grid points rather than the points themselves.



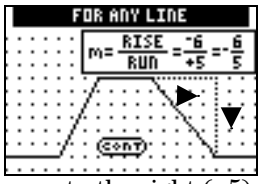
- In the screen below, the rise/run of the fourth segment is calculated as -6/5. For some students, associating "down 6 units, or -6" with the word *rise* can be confusing. The use of the terms *vertical change* or *horizontal change* helps students understand that *change* could be up or down, right or left.



Common Student Errors (continued)

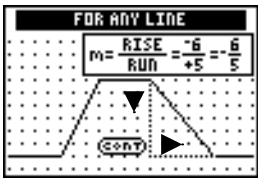
- Students can calculate the slope for the fourth segment in four ways.

 With the animation to show direction, students usually will begin counting with the upper left-hand point on the segment.



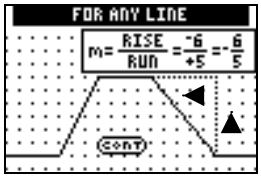
5 spaces to the right (+5) and
6 spaces down (-6)
to get -6/5

or



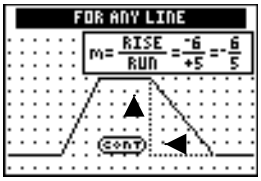
6 spaces down (-6) and
5 spaces to the right (+5)
to get -6/5

 Without the animation to show direction, students may be as likely to begin counting from the lower right-hand point on the segment.



6 spaces up (+6) and
5 points to the left (-5)
to get 6/-5

or



5 points to the left (-5) and
6 spaces up (+6)
to get 6/-5

 Slope = $m = \frac{6}{-5} = \frac{-6}{5} = -\frac{6}{5}$

 All four ways of counting are correct, resulting in the same slope. The **Observations** reinforce this, stating, "The slope between any two points on a line is always the same ratio."

Student Worksheet Notes with Answers

Overview

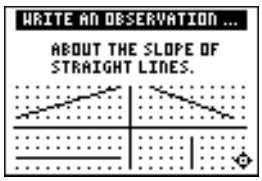
Tell students:

1. How to find the **Overview**, or tell them to review the instructions on the worksheet.
2. How to navigate the application, if they are not yet familiar with the application.
3. To scroll through the **Overview** on the calculator. Point out the new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

Observations

The **Observations** help students understand the slope of a straight line.

If necessary, tell students how to find the **Observations** for this section.



Observation 1

Students write what they observe about the slope of straight lines.

Answers may vary. Students observe that a line has constant slope.

Activities



Scoring: Students get two attempts to solve each problem. They earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

Students can earn up to 10 points.

Screen Cross

Tell students to:

1. Read the directions on the screen, and then press any key to continue.

 Note: Repeat steps 2 and 3 for line segments 2 through 5.

2. Calculate the slope between the two endpoints. Record their work.

3. Press ▲ or ▼ to view the choices for the slope (**UNDEF** = undefined slope). When they think the correct slope is displayed, press ENTER.

4. Record the endpoints and slopes for each segment and their final score. The segments are different on each calculator and each time the game is played.



Scoring: There are no points awarded in the linked version. Students must answer correctly before the next line segment is shown.

The player who reaches the right side of the grid first wins.

Linked Calculators Screen Cross

Tell students to:

1. Connect two similar calculators using a unit-to-unit cable.

2. Use the grid to help determine as quickly as possible the slope of the line segment.

3. Select the slope as they did in Screen Cross.

4. Record which player won.

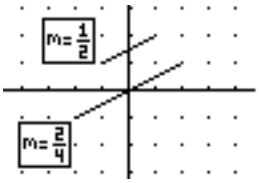
Try-It!™ on Your TI-83 Plus or TI-73

Students follow the example, which covers drawing a line on the graph screen from specified endpoints using the **Draw** menu.

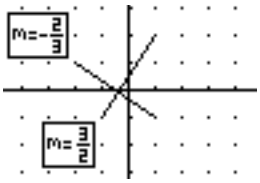
Draw the Slopes!

1. These are sample answers only. Segment location varies depending on the starting point used.

a. and b.



c. and d.



2. Students should notice that their segments are not necessarily the same as others depending on the starting point used. Later, they will see that the slope **and** a point determine a line.

3. Students should notice that 1/2 and 2/4 have the same steepness. These segments are parallel (or on the same line). They should also observe that segments with slopes, -2/3 and 3/2, are perpendicular line segments. See graphs above.

Name _____
Date _____

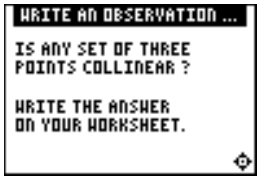
Linear Functions: Slope Using Coordinates — Student Worksheet

Overview

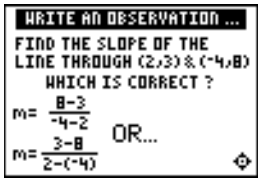
The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

Observations

The **Observations** illustrate mathematical concepts relating to finding the slope using graph coordinates. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



Is every set of three coordinate points collinear? Write your thoughts below.



Which is the correct way to calculate the given slope? Write your thoughts below.

Activities

The **Activities** section helps you practice finding a slope using graph coordinates. You can select from two activities—**Screen Cross** or **Linked Calculators Screen Cross**. Follow these steps to play the activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.

2. Highlight an activity using ▲ or ▼, and press ENTER.

Name _____
Date _____

Activities (continued)



Scoring: You get two attempts to solve each problem. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

You can earn up to 10 points.

Screen Cross

This activity is similar to the Screen Cross in the Slope with Grid section. There is no grid displayed, but the endpoints are given.

1. Read the directions on the screen, and then press any key to continue.

 Note: Repeat steps 2 and 3 for line segments 2 through 5.

2. Calculate the slope between the two points. Record your work below.

3. Press ▲ or ▼ to view the choices for the slope (**UNDEF** = undefined slope). When you think the correct slope is displayed, press ENTER.

	point 1 (x_1,y_1)	point 2 (x_2,y_2)	slope
segment #1	_____	_____	_____
segment #2	_____	_____	_____
segment #3	_____	_____	_____
segment #4	_____	_____	_____
segment #5	_____	_____	_____

4. What was your score? _____



Scoring: There are no points awarded in the linked version. You must answer correctly before the next line segment is shown.

The player who reaches the right side of the grid first wins.

Linked Calculators Screen Cross

Play Screen Cross against another student. Race another student across the screen by calculating the slopes more quickly than your opponent.

1. Connect two similar calculators using a unit-to-unit cable.

2. Use the grid to help determine as quickly as possible the slope of the line segment.

3. Select the slope as you did in Screen Cross.

4. The player who reaches the right side of the grid first wins.

5. Who won? _____

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73

Use the calculator to find the slope of a line through the points (2,6) and (7,4).

The slope is: $m = \frac{6 - 4}{2 - 7}$

To Do This on the TI-83 Plus	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. Calculate the slope.	(**6** − **4**) ÷ (**2** − **7**) ENTER	(6−4)/(2−7) -.4
3. Change the fraction to a decimal. Use the **▸Frac** function on the MATH **MATH** menu.	MATH **1:▸Frac** ENTER	(6−4)/(2−7) -.4 Ans▸Frac -2/5

To Do This on the TI-73	Press	Display (TI-73 shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. Calculate the slope.	(**6** − **4**) ÷ (**2** − **7**) ENTER	(6−4)/(2−7) -.4
3. Change the decimal to a fraction.	F↔D ENTER	(6−4)/(2−7) -.4 -.4▸F↔D -2/5
4. Simplify the fraction. **Note**: The mode setting **ManSimp** must be selected first. For more information, see TIp 2: *Adjusting Your Calculator Settings*.	MODE ▼ ▼ ▼ ▼ ▶ to **ManSimp** ENTER SIMP ENTER	(6−4)/(2−7) -.4 -.4▸F↔D ↓-4/10 -4/10▸Simp Fac=2 -2/5
5. Use b/c to enter the problem.	b/c **6** − **4** b/c **2** − **7** ENTER	6−4 / 2−7 -2/5

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Additional Problems

1. Calculate the same problem, $m = \frac{6 - 4}{2 - 7}$, on the calculator from the Home screen, using the following keystrokes:

 6 [−] 4 [÷] 2 [−] 7 [ENTER]

 Did you get the same answer? If not, why not? Which answer is correct?

2. Find the slope of the line containing the given points using the calculator. Who can do these problems faster, the calculator or you? You can also pair with another student and challenge each other to see who is faster at the calculations. Write your calculations and answers.

 a. (3,-4) and (-2,8)

 b. (-12,17) and (5,-6)

 c. (36,6) and (-25,6)

 d. (1.36,2.54) and (1.36,5.72)

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Linear Functions: Slope Using Coordinates Teacher Notes

Objectives

- To introduce slope as a ratio as the change in y to the change in x.
- To find the slope of a line using the slope formula.
- To illustrate the characteristics of lines with positive, zero, negative, or undefined slope.
- To associate *increasing*, *horizontal*, *decreasing*, or *vertical* with the appropriate slope.

Math Highlights

This section again highlights a review of slope as the steepness of a line. The section opens with a bike riding along a piecewise linear path. Students see the definition of slope as a ratio.

$$\text{Slope} = m = \frac{\text{rise}}{\text{run}} = \frac{\text{change in y}}{\text{change in x}} = \frac{y_2 - y_1}{x_2 - x_1}$$

Several examples of the calculations are shown. Next, the characteristics of lines with positive, zero, negative and undefined slopes are summarized.

Common Student Errors

- Many students are concerned that they have to know which point is (x_1, y_1) and which point is (x_2,y_2). Show that both calculations give the same answer. In the second example below, some students are confused when they see division with two negative numbers results in a positive slope. Discuss this. For the line containing the points (0,0) and (10,2), the slope is calculated by:

$$\frac{2-0}{10-0} = \frac{1}{5} \quad \text{or} \quad \frac{0-2}{0-10} = \frac{-1}{-5} = \frac{1}{5}$$

- Watch for an incorrect substitution where students switch the order in the numerator or denominator. For the example above,

$$\text{Incorrect: } \frac{0-2}{10-0} \quad \text{or} \quad \frac{2-0}{0-10}$$

- This is a good opportunity to open a discussion on different representations of the same number. Students might write a calculator answer without thinking about whether or not the representation is the best for the problem. Ask when it is most useful to have the slope represented in decimal form versus in fraction form.
- Remind students that they need to use the Order of Operations rules.
- In the Try-It!™ section, the correct calculation is $(6 - 4) \div (2 - 7)$, not $6 - 4 \div 2 - 7$ (where division would be performed before subtraction).

Student Worksheet Notes with Answers

Overview

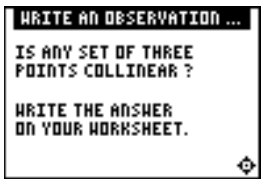
Tell students:

1. How to find the **Overview**, or tell them to review the instructions on the worksheet.
2. How to navigate the application, if they are not yet familiar with the application.
3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

Observations

The **Observations** help students understand mathematical concepts relating to finding the slope using graph coordinates.

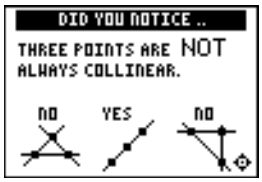
If necessary, tell students how to find the **Observations** for this section.

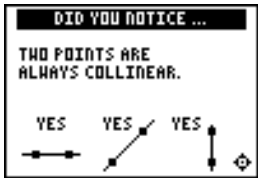


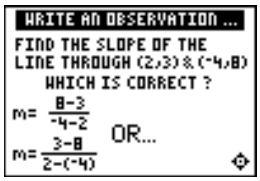
Observation 1

Is any set of three points collinear?

Three points may be collinear, but are not necessarily collinear.



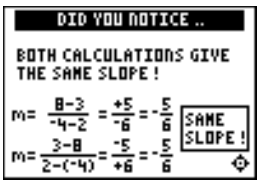




Observation 2

Find the slope of the line through (2,3) and (-4,8).

Students can pick either point as (x_1,y_1) and (x_2,y_2) to compute the slope using the formula.



Activities



Scoring: Students get two attempts to solve each problem. They earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

Students can earn up to 10 points.

Screen Cross

Tell students to:

1. Read the directions on the screen, and then press any key to continue.

 Note: Repeat steps 2 and 3 for line segments 2 through 5.

2. Calculate the slope between the two points. Record their work.

3. Press ▲ or ▼ to view the choices for the slope (**UNDEF** = undefined slope). When they think the correct slope is displayed, press ENTER. Record the endpoints and slopes for each segment. The segments are different on each calculator and each time the game is played.

4. Record their final score.



Scoring: There are no points awarded in the linked version. Students must answer correctly before the next line segment is shown.

The player who reaches the right side of the screen first wins.

Linked Calculators Screen Cross

Tell students to:

1. Connect two similar calculators using a unit-to-unit cable.

2. Try to determine as quickly as possible the slope of the line segment.

3. Select the slope as they did in Screen Cross.

4. The player who reaches the right side of the screen first wins.

Try-It!™ on Your TI-83 Plus or TI-73

Students investigate how to input the calculation for slope on the Home screen. See the Student Worksheet for instructions.

Warn students about the correct use of parentheses. They need to be reminded of the Order of Operations rules. Notice that the TI-73 has stacked fraction capabilities; therefore, the calculation is performed correctly without parentheses.

Additional Problems

1. Students input **6–4/2–7** in the calculator. The calculator computes $6 - (4 \div 2) - 7 = -3$ since division is performed before subtraction according to the Order of Operation rules. This is *not* the correct answer. Students need to be aware that parentheses, such as $(6 - 4) \div (2 - 7)$, override the Order of Operation rules.

2. Students practice calculating the slope using the calculator, but remind students that they can compute these answers faster than the calculator can! Pair students and challenge them to try to beat the calculator.

 a. (3,-4) and (-2,8) $slope = -\frac{12}{5}$

 b. (-12,17) and (5,-6) $slope = -\frac{23}{17}$

 c. (36,6) and (-25,6) $slope = 0$

 d. (1.36,2.54) and (1.36,5.72) *slope* = undefined

Name _____
Date _____

Linear Functions: Slope as Rate of Change — Student Worksheet

Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

Observations

The **Observations** illustrate mathematical concepts relating to finding the slope using graph coordinates. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



What kinds of graphs have a nonconstant rate of change?

Name _____
Date _____

Activities

The **Activities** section helps you practice finding a slope as rate of change. You can select from two activities—**Balloon Speed** or **Dive**. Follow these steps to play the activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.
2. Highlight an activity using ▲ or ▼, and press ENTER.



Scoring: You get two attempts to solve each problem. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

You can earn up to 10 points.

Balloon Speed

1. Highlight a level (bronze = least difficult; gold = most difficult), and press ENTER to select it.
2. Select whether you want to play during **Nighttime** or **Daytime**.
3. Take a trip in the balloon. Record the times and positions in the table.
4. Calculate the rate of change (the slope) of each trip, showing all work, including the correct units. Enter the rate and press ENTER. If the answer is incorrect, the correct answer is displayed; press any key to resume play.
5. What level did you play? _____
6. What was your score? _____

Trip	Start Time	Start Position	Stop Time	Stop Position	Speed (include units)
1					
2					
3					
4					
5					

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Name _____
Date _____

Activities (continued)



Scoring: You get one attempt to select the correct row. If you select an incorrect row, the correct row is identified.

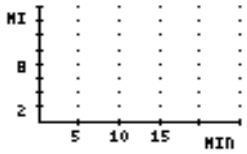
Dive

1. Take a dive in the submarine. Record the times and positions in the table below.
2. Calculate the rate of change (slope) of each segment in the table below. Show all your work. Include the correct units.
3. After the third segment, the next screen displays three rows of three rates. Use your rate answers from the table to determine the correct row. To select a row, press ▼ or ▲ to move the submarine cursor, and then press ENTER.
4. Did you select the correct row? _____

Segment	Start Time	Start Position	Stop Time	Stop Position	Speed (include units)
1					
2					
3					

Car Trip Word Problem

A car takes a 20-minute trip. The car starts at home, (0,0). It travels 6 miles in 10 minutes. The car stops in traffic for 5 minutes. The driver forgot something at home so the car returns in 5 minutes. Draw a straight-line graph of the trip. Write the rate of change for each leg of the trip on the graph to the right.



Name _____
Date _____

Try-It!™ on Your TI-83 Plus

See the section on *Slope Using Coordinates* to find out how to use your calculator to find the slope of a line containing two given points. Review the keystrokes. Use these keystrokes to compute the rate of change for each pair of data points given. Include the correct units with your answer.

1.

x (seconds)	y (feet)
10	6.72
20	8.05

Rate of Change _____

2.

x (hour)	y (phone calls)
2	18
4	25

Rate of Change _____

3. A space shuttle has an average velocity of 25,405 ft/sec. The velocity of a car on a highway can be 60 mi/hr. To find out how many times faster the space shuttle travels compared to the car, you must convert the speed of the space shuttle to miles per hour. First, look at the conversion by hand, and then do it on the calculator. When set to **Float**, the calculator shows the answer to five decimal places.

$$25{,}405\,\frac{\text{ft}}{\text{sec}} \times \frac{60\text{ sec}}{1\text{ min}} \times \frac{60\text{ min}}{1\text{ hr}} \times \frac{1\text{ mi}}{5280\text{ ft}} = 17321.59091\,\frac{\text{mi}}{\text{hr}}$$

To Do This	Press	Display (TI-83 Plus shown)
1. If necessary, exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. Calculate 25,405 × 60 × 60 / 5,280.	**25405** × **60** × **60** ÷ **5280** ENTER	25405*60*60/5280 17321.59091

3. How many times faster does the space shuttle travel compared to the car? _____

Additional Problems

Try these by hand, and show your work below. Then check the answers on your calculator.

5280 feet = 1 mile 1000 meters = 1 kilometer
60 seconds = 1 minute 60 minutes = 1 hour

1. 55 miles/hour → feet/second

2. 35 meters/second → kilometers/hour

Name _____
Date _____

Try-It!™ on Your TI-73

See the section on *Slope Using Coordinates* to find out how to use your calculator to find the slope of a line containing two given points. Review the keystrokes. Use these keystrokes to compute the rate of change for each pair of data points given. Include the correct units with your answer.

1.

x (seconds)	y (feet)
10	6.72
20	8.05

Rate of Change _____

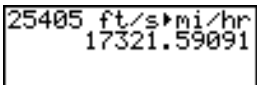
2.

x (hour)	y (phone calls)
2	18
4	25

Rate of Change _____

3. A space shuttle has an average velocity of 25,405 ft/sec. The velocity of a car on a highway can be 60 mi/hr. To find out how many times faster the space shuttle travels compared to the car, you must convert the speed of the space shuttle to miles per hour. First, look at the conversion by hand, and then do it on the calculator. When set to **Float**, the calculator shows the answer to five decimal places.

$$25{,}405\ \frac{\text{ft}}{\text{sec}} \times \frac{60\ \text{sec}}{1\ \text{min}} \times \frac{60\ \text{min}}{1\ \text{hr}} \times \frac{1\ \text{mi}}{5280\ \text{ft}} = 17321.59091\ \frac{\text{mi}}{\text{hr}}$$

To Do This	Press	Display (TI-73 shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. Enter the velocity, 25,405 on the Home Screen.	**25405**	
3. Open the **CONVERSIONS** menu, and select the category, **Speed**.	2nd [CONVERT] **7:Speed**	
4. Select the units you are converting *from*, **ft/sec**.	**1:ft/sec**	
5. Select the units you are converting *to*, **mi/hr**. 25,405 ft/s rounded to tenths is **17321.6 mi/hr**.	**3:mi/hr** ENTER	

6. How many times faster does the space shuttle travel compared to the car?_____

Name _____
Date _____

Try-It!™ on Your TI-73 (continued)

Additional Problems

Try these by hand, and show your work below. Then check the answers on your calculator.

5280 feet = 1 mile	1000 meters = 1 kilometer
60 seconds = 1 minute	60 minutes = 1 hour

1. 55 miles/hour → feet/second

2. 35 meters/second → kilometers/hour

Linear Functions: Slope as Rate of Change — Teacher Notes

Objectives

- To associate the slope of a straight line with a constant rate of change.
- To calculate the rate of change from data points on a line, using the correct units.
- To read from a linear graph: the rate of change, the scale of the axes, and the correct units.

Math Highlights

This section highlights the use of the slope formula to find the rate of change from graphs and data. Students may need to review the slope formula; see previous sections on the calculator.

$$\text{rate of change} = m = \frac{y_2 - y_1}{x_2 - x_1} \text{ units}$$

Emphasize the use of appropriate units. For example, in the **Fill the Pool** example in the **Overview**, the students see a pool filling at a constant rate of change. Two data points from the growth graph or table shown are (4,2) and (6,3). To find the slope, students should calculate:

$$\text{rate of change} = m = \frac{3 - 2}{6 - 4}\frac{\text{ft}}{\text{hr}} = \frac{1}{2}\frac{\text{ft}}{\text{hr}} = .5\frac{\text{ft}}{\text{hr}}$$

Mention to students that if the graph of a real problem were nonlinear, the calculation of the rate of change using two data points gives the *average* rate of change over the interval chosen.

Common Student Errors

- Neglecting to write the appropriate units.
- Misunderstanding how to use the *position* with respect to a starting place rather than distance. In the slope formula, $y_2 - y_1$ gives the *signed distance* traveled.
- Specifying which point is (x_1,y_1) and which point is (x_2,y_2). Show students that both calculations give the same answer. Some students are confused when they see a division by two negative numbers that results in a positive growth. Discuss this with the students. Watch for an incorrect substitution where students switch the order in the numerator or denominator. For example, if the data points (0,0) and (10,2) give the growth of a plant in cm per day, the rate of change is calculated:

 Correct: $\frac{2 - 0}{10 - 0}\frac{\text{cm}}{\text{day}} = \frac{1}{5}\frac{\text{cm}}{\text{day}}$ *or* $\frac{0 - 2}{0 - 10}\frac{\text{cm}}{\text{day}} = \frac{-1}{-5}\frac{\text{cm}}{\text{day}}$

 Incorrect: $\frac{0 - 2}{10 - 0}\frac{\text{cm}}{\text{day}}$

- Students need to be exposed to other variables besides x and y. For example, it is useful to use t for time and d for distance.

Student Worksheet Notes with Answers

Overview

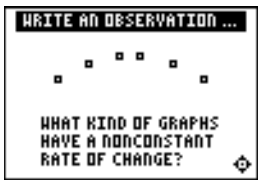
Tell students:

1. How to find the **Overview** or tell them to review the instructions on the worksheet.
2. How to navigate the application, if they are not yet familiar with the application.
3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

Observations

The **Observations** help students understand mathematical concepts relating to finding the slope using graph coordinates.

If necessary, tell students how to find the **Observations** for this section.

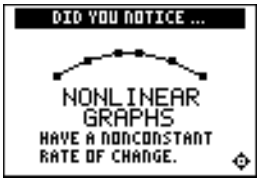


Students see the answer on the screen at the right.

Observation 1

What kinds of graphs have a nonconstant rate of change? Students write their answer on their worksheet.

Nonlinear graphs have a nonconstant rate of change.



Activities



Scoring: Students get two attempts to solve each problem. They earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

Students can earn up to 10 points.

Balloon Speed

Tell students to:

1. Highlight a level (bronze = least difficult; gold = most difficult), and press ENTER to select it.
2. Select whether they want to play during **Nighttime** or **Daytime**.
3. Take a trip in the balloon. Record the times and positions in the table.
4. Calculate the rate of change (the slope) of each trip, showing all work, including the correct units. Enter the rate and press ENTER. If the answer is incorrect, the correct answer is displayed; press any key to resume play.
5. Record the level they played.
6. Record their score.



Scoring: You get one attempt to select the correct row. If you select an incorrect row, the correct row is identified.

Dive

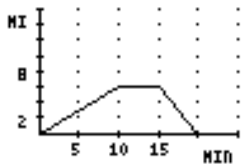
Tell students to:

1. Take a dive in the submarine. Record the times and positions in the table below.
2. Calculate the rate of change (slope) of each segment in the table on the worksheet, showing all their work, including the correct units.
3. After the third segment, the next screen displays three rows of three rates. Students use their rate answers from the table to determine the correct row. To select a row, press ▼ or ▲ to move the submarine cursor, and then press ENTER.
4. Record whether they selected the correct row.

Activities (continued)

Car Trip Word Problem

Distance	Rate
(0,0) to (10,6)	.6 mi/min
(10,6) to (15,6)	0 mi/min
(15,6) to (20,0)	-1.2 mi/min



Notice that the rate is positive going away from home. The rate is negative on the return part of the trip indicating the direction of going back home.

Try-It!™ on Your TI-83 Plus or TI-73

Note: There is a Try-It for the TI-83 Plus and one for the TI-73; they are on separate pages.

Students review using the calculator to compute the slope of a line containing two points. They also see how to use the calculator to do conversions. The TI-73 has conversion functionality whereas users of the TI-83 Plus have to know how to set up the conversion. See the Student Worksheet for instructions.

1. *0.133 ft per sec*

2. *3.5 phone calls per hour*

Have students discuss the meaning of the rates and their choice of representation. For example, is 3.5 phone calls per hour the most meaningful way of communicating the rate of change or is 7 phone calls every two hours a better way of describing the rate? Have students justify their reasoning.

3. (TI-83 Plus) or *6.* (TI-73)
The space shuttle travels 288.7 times faster than a car (17321.59091 m⁄hr ÷ 60 mi⁄hr).

Calculator Problems

Tell students to follow the steps exactly on the calculators. Example screens are displayed on the worksheets for students to compare with the calculator screens.

Additional Problems

Students work problems by hand and check on calculator.

1. $80\frac{2}{3}\frac{ft}{sec} = 80.\overline{6}\ \frac{ft}{sec}$

2. $126\frac{km}{hr}$

Name _____
Date _____

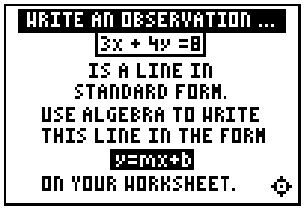
Linear Functions: Slope-Intercept Form — Student Worksheet

Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

Observations

The **Observations** illustrate mathematical concepts relating to writing slope in slope-intercept form. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



Observation

Use your algebraic knowledge to change $3x + 4y = 8$ to the form $y = mx + b$. Show your work.

Remember: $3x + 4y = 8$ is Standard Form.

Activities

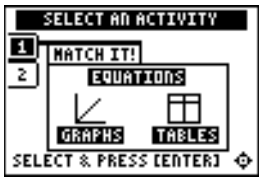
The **Activities** section helps you practice using the slope-intercept form of lines. You can select from two activities—**Match It!** or **Line Soccer**. Follow these steps to play the activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.
2. Highlight an activity using ▲ or ▼, and press ENTER.

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Name _____
Date _____

Activities (continued)

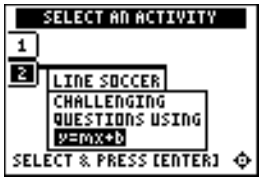


Scoring: You get two attempts to answer the problem. You earn 2 points for a correct answer, 1 point for a correct answer on the second try.

You can earn up to 12 points.

Match It!

1. Select the correct answer to the question. Questions include:
 - Selecting the graph that correctly illustrates an equation.
 - Selecting the equation that correctly describes a graph.
 - Selecting the equation that goes with the table.
2. What was your score? _____



Scoring: You get two attempts to answer the problem. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

You score a goal when you answer a question correctly against Alex, the goalkeeper. You also get to keep any points you earned while passing the ball.

Line Soccer

1. Pass the ball by answering a question correctly. Possible slope-intercept questions include:
 - Selecting the (**x**,**y**) coordinate that solves an equation.
 - Using an (**x**,**y**) coordinate and **b** to solve for **m** in an equation.
 - Using an (**x**,**y**) coordinate and **m** to solve for **b**.
 - Using two (**x**,**y**) coordinates to calculate **m** and **b**.
2. To enter your answer:
 - As a negative number, press [(-)].
 - As a mixed number, enter the whole number and press ⟨**UNIT**⟩, and then enter the fraction.
 - As a fraction, press ⟨**n/d**⟩ and enter the numerator. Press ⟨**n/d**⟩ again and enter the denominator.
3. Show your work for each problem:

4. What was your score? _____

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Name _____
Date _____

Activities (continued)

Additional Problems

1. Make a table and draw the graph for the following linear functions.

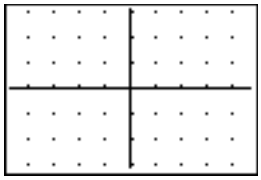
 a. $Y = -X + 2$

X	Y

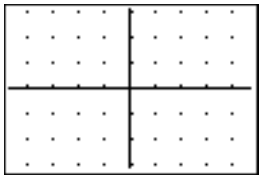
 

 b. $Y = 2X - 1$

X	Y

2. Think of the graph below as a map. You start to walk from the point (-1,1). You can walk only along a path that is the line with the slope: $m = -2$

 a. Label two points, A and B, that you can walk to on the graph if the slope of your path =-2. Each tick mark is 1 unit.

 b. Find the equation of the line that describes your walking path. Show your work below.

 c. Record the coordinate points of A and B below. Use the equation of your path to check to see if your points A and B are on really on your line! Show your work below.

Point	Check It
A=	
B=	

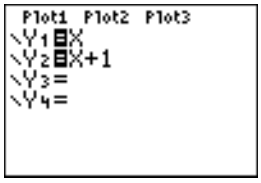
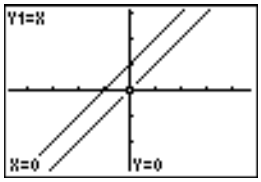
Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73

Parent and Family of Functions

Compare graphs of **Y1=X** and **Y2=X+1**. If you know the graph of **Y1=X**, can you draw the graph of any line in slope-intercept form? Investigate using your calculator!

Note: See TIp™ 3: *Graphing a Function* and TIp™ 5*: Adjusting the Viewing Window* for instructions if you need help. Set up your calculator so that **GridOn** on the window format ([2nd] [FORMAT]) screen and **ZDecimal** on the zoom menu ([ZOOM]) are selected.

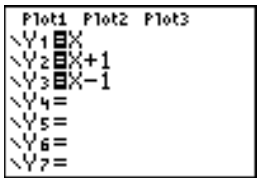
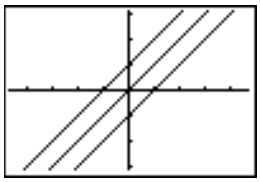
To Do This	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	[2nd] [QUIT] ⟨**EXIT**⟩ [CLEAR]	
2. Define **Y1=X** and **Y2=X+1**. **Note**: On the TI-73, use [x] rather than [X,T,Θ,n].	[Y=] [CLEAR] [X,T,Θ,n] [▼] [CLEAR] [X,T,Θ,n] [+] **1**	
3. Set the viewing window.	TI-83 Plus: [ZOOM] **4:ZDecimal** TI-73: [ZOOM] **8:ZDecimal**	
4. Trace both **Y1** and **Y2**.	[TRACE] [◄] or [►] to trace a function [▲] and [▼] to move between functions	

5. Write a description of what you see. How does the graph of **Y=X** compare to the graph of **Y=X+1**?

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Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

To Do This	Press	Display (TI-83 Plus shown)
6. Enter and trace **Y3=X−1**. **Note**: On the TI-73, use [x] rather than [X,T,Θ,n].	[Y=] [▼] [▼] [CLEAR] [X,T,Θ,n] [−] **1** [TRACE] [◄] or [►] to trace a function [▲] and [▼] to move between functions	 

7. Write a description of what you see. How does the graph of **Y=X** compare to the graph of **Y=X−1**?

8. Where will the line, **Y=X+2** be located? Draw in your prediction and then use the calculator to check your work. Was your graph correct? If not, why not?	
9. Now predict and draw the following lines on the graph to your right. Draw your own axes. Do not use the calculator. Y=X+3 Y=X−3 Y=X+8 Y=X−8	

10. Check your work! Graph each line on the calculator. Could you see all of the lines? Record your observations.

Note: On the TI-73, you need to clear a line in the Y= editor to make room for your new lines.

11. You cannot see **Y=X+8** or **Y=X-8** on your graphing calculator. Why do you think that the line is not showing? Change your **WINDOW** ([WINDOW]) settings so that you are able to see these lines. Record the changes you made.

12. Compare the lines: **Y=X**, **Y=2X**, and **Y=3X**. What do you notice? Try other lines in the form Y = AX. Next, try to graph **Y=2X+3** without the calculator. Explain your strategy.

Linear Functions: Slope-Intercept Form Teacher Notes

Objectives

- To review the form of the equation y = mx + b, where m is slope and b is the y-intercept.
- To view graphing lines and developing equations from data.
- To view tables of values and graphing lines from an equation of the form y = mx + b.
- To emphasize three ways of looking at lines, tables, graphs and equations.
- To develop the equation of a line from information given, such as slope and y-intercept, point and slope, and two points.
- To review the slope of parallel and perpendicular lines.

Math Highlights

This section highlights a review of the slope-intercept form of a line, y = mx + b. Students will review graphing a line using one point and the slope of the line. They will also see the equation of a line developed inductively from data by simulating the amount of volts produced by lining up batteries in series. Students will also review how to find a table and graph a line using the equation y = mx + b.

A review of calculations follow, which show the step-by-step procedures needed to find the equation of a line given, the slope and y-intercept, the slope and a point on the line, and finally two points.

Common Student Errors

- When students perform the calculations to find the equation of a line given the slope and y-intercept, the slope and a point on the line, or two points, they often have problems following the steps. For example, given two points, the student needs to perform three steps. First, the student needs to calculate the slope of the line. Students may forget the formula for slope, and then be careless about substituting the correct values in the formula. Also, they may make errors in sign. In the second step, they need to find b using the calculated slope and one of the points. Students need to understand that they could pick either point for this calculation. If the slope is incorrect from the first step, the error cascades into the rest of the solution. In the third step, they need to place all of the information into the final answer as y = mx + b.
- Students become comfortable using the variables x and y. They should be exposed to the use of other letters for the independent and dependent variables. Students should be able to recognize, for example, D = 2T + 4 as a linear relationship with independent variable T, dependent variable D, a slope of 2 and the D-intercept as 4. They need to learn that they will need to change the variables so the function reads y = 2x + 4 in order to graph it on the calculator.

Student Worksheet Notes with Answers

Overview

Tell students:

1. How to find the **Overview**, or tell them to review the instructions on the worksheet.
2. How to navigate the application, if they are not yet familiar with the application.
3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

Observations

The **Observations** help students understand using algebra to change a linear equation in standard form to slope-intercept form.

If necessary, tell students how to find the **Observations** for this section.



Observation

Students use algebra to write 3x+4y=8 in y=mx+b form.

Answers may vary, especially the step order. One possible answer:

Step 1*: Subtract 3x from both sides of the equation.*

$$3x - 3x + 4y = 8 - 3x$$

Step 2*: Simplify the equation.*

$$4y = -3x + 8$$

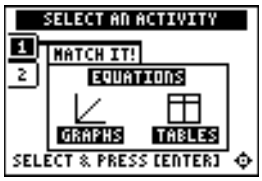
Step 3*: Divide both sides of the equation by 4.*

$$\frac{4y}{4} = \frac{-3}{4}x + \frac{8}{4}$$

Step 4*: Simplify to get the answer.*

$$y = \frac{-3}{4}x + 2$$

Activities



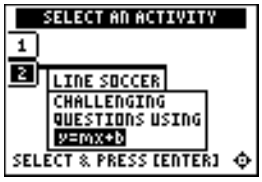
Scoring: Students get two attempts to answer the problem. They earn 2 points for a correct answer, 1 point for a correct answer on the second try.

Students can earn up to 12 points.

Match It!

Tell students to:

1. Select the correct answer to the question. Questions include:
 - Selecting the graph that correctly illustrates an equation.
 - Selecting the equation that correctly describes a graph.
 - Selecting the equation that goes with the table.
2. Record their scores.



Scoring: Students get two attempts to answer the problem. They earn 2 points for a correct answer, 1 point for a correct answer on the second try.

Students score a goal when they answer a question correctly against Alex, the goalkeeper. They also get to keep any points they earned while passing the ball.

Note: Unsimplified fractions are counted as correct.

Line Soccer

Tell students to:

1. Pass the ball by answering a question correctly. Possible slope-intercept questions include:
 - Selecting the (**x**,**y**) coordinate that solves an equation.
 - Using an (**x**,**y**) coordinate and **b** to solve for **m** in an equation.
 - Using an (**x**,**y**) coordinate and **m** to solve for **b**.
 - Using two (**x**,**y**) coordinates to calculate **m** and **b**.
2. Enter their answers in the following ways, as necessary:
 - as a negative number, press [(-)].
 - as a mixed number, enter the whole number and press ⟨**UNIT**⟩, and then enter the fraction.
 - as a fraction, press ⟨**n/d**⟩ and enter the numerator. Press ⟨**n/d**⟩ again and enter the denominator.
3. Show their work for each problem.
4. Record their scores.

Activities (continued)

Additional Problems

1. Students make a table and draw the graph for **Y=⁻X+2** and **Y=2X−1**.

 Answers may vary. Make sure that students correctly label the axes and all points from the corresponding table.

2. Students label two points, A and B, where the line segment between the two has a slope that is ⁻2.

 a. *Possible points students can walk to on the screen shown are* (⁻2,3), (0,⁻1), *and* (1,⁻3).

 b. *Students should use* $m=-2$ *and the point; for example,* (⁻1,1) *to find the y-intercept, b. The answer is* $y=-2x-1$.

 c. *Students should substitute their point in the line to see if the equation is satisfied.*

Try-It!™ on Your TI-83 Plus or TI-73

Students need to know the features of the calculator covered in TIp™ 3: *Graphing a Function* and TIp™ 5: *Adjusting the Viewing Window*. They work through an investigation of parent and family of functions of **Y=X**. See Student Worksheet for details.

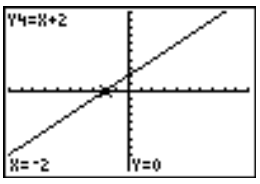
Tell students to follow the steps exactly on the calculators. Example screens are displayed on the worksheets for students to compare with the calculator screens.

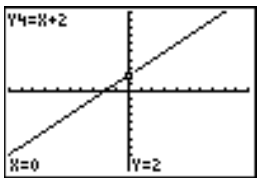
This keystroke exercise lets students discover the connection between the parent and family of functions so they can quickly graph functions of the form **y=mx+b**.

5. Possible answers for comparing the graph of **Y=X** to **Y=X+1**: *parallel, equivalent slope, offset by* 1, **Y=X** *crosses the origin* (0,0), etc.

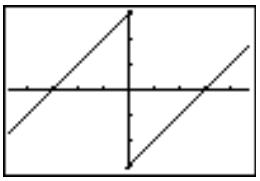
7. Possible answers for comparing the graph of **Y=X** to **Y=X−1**: *same as above.*

8. Students should draw the function on the worksheet first before graphing it on the calculator. **Y=X+2** *intersects the X-axis at (⁻2,0) and the Y-axis at (0,2).*





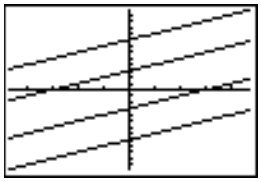
10. Students should draw the function on the worksheet first before graphing it on the calculator. If they graph it without changing the window values, the screen looks like this:



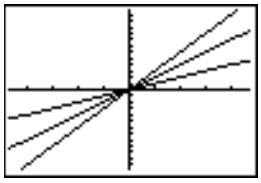
Try-It!™ on Your TI-83 Plus or TI-73 (continued)

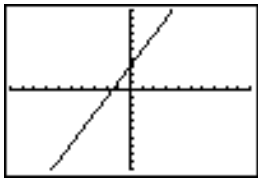
Parent and Family of Functions

11. Students cannot see all functions when they don't change their window values, which are: **Xmin=⁻4.7**, **Xmax=4.7**, **Xmin=⁻3.1**, **Xmax=3.1**. To fit all functions on the screen, **Xmin>8** and **Xmax>8**. Functions in order from top to bottom: **Y=X+8**, **Y=X+3**, **Y=X–3**, **Y=X–8**.



12. In order from top to bottom: **Y=3X**, **Y=2X**, **Y=X** (**ZFit** window values). Graph of **Y=2X+3** (**ZStandard** window values). To graph the function **Y=2X+3**, students should think that the graph is parallel to **Y=2X**, and then shift **Y=2X** up 3 units on the Y-axis.





Name _____
Date _____

Linear Inequalities: Using Graphs & Tables — Student Worksheet

Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

Observations

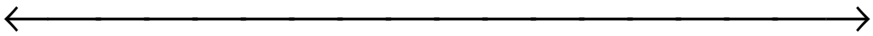
The **Observations** illustrate mathematical concepts relating to inequalities. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



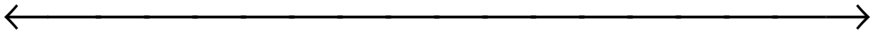
Observation 1

If **x** is a real number, draw the number line graph of each inequality. Remember to use open and closed notation and to label each number line correctly.

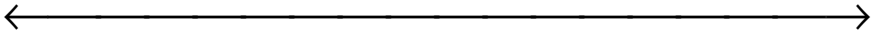
1. **x < 3**



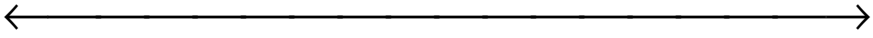
2. **x ≤ 3**



3. **x > 6**



4. **x ≥ 6**

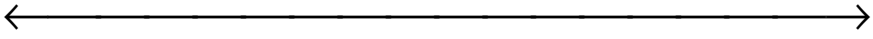


Draw the number line graphs for these inequalities (which are not in the Topics in Algebra 1 application).

5. $x > -\frac{1}{2}$



6. **x ≤ 1.25**



Name _____
Date _____

Activities

The **Activities** help you practice using graphs and tables to solve inequalities. You can select from three different activities—**Build the Solution Set!, Worksheet Activity 1**, and **Worksheet Activity 2**. Follow these steps to play the activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.

2. Highlight an activity using ▲ or ▼, and press ENTER.



Scoring: There are five problems in each set. You get two attempts to solve for **x** for each problem. You get 2 points for a correct choice on the first try, and 1 point for a correct choice on the second try.

You can earn up to 10 points.

Build the Solution Set!

1. Use ◄ or ► to move the cursor along the number line. Press ENTER to select the first point to test. The point is displayed along with the result of the test.

2. Choose another point to test. After the point and result of the test for the second point are displayed, four possible solutions for **x** are displayed.

3. Press ◄ or ► to highlight the correct solution, and then press ENTER to select it. If you choose an incorrect solution on the first try, you get another try. If you choose an incorrect solution on the second try, the correct answer is displayed; press any key to go to the next problem. As you play the activity, write the inequalities and their solutions.

4. What was your score? _____

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Name _____
Date _____

Activities (continued)



Note: Press ◄ or ► to leave this screen.

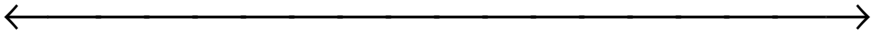
Worksheet Activity 1

Use the number lines below to estimate the solution set of the following inequalities. Use number sense to place a scale on each number line so that you are able to show the solution set. Check several points as shown in the previous activity. Show all of your work.

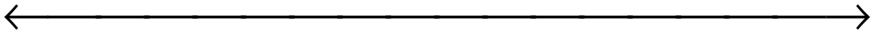
1. **$x + 2.5 < 7$**

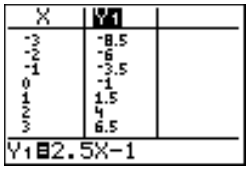


2. **$x - 3.6 \leq -2$**



3. **$x + \frac{3}{4} > 4\frac{1}{8}$**

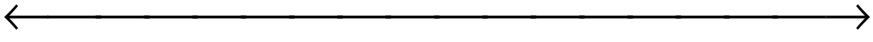




Worksheet Activity 2

Use the table of the expression **2.5X–1** at the left to find out when **2.5X–1<3**. First estimate the answer, and then use number sense to determine the exact answer. Write your strategy for the solution, and draw the solution set on a number line.

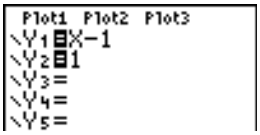
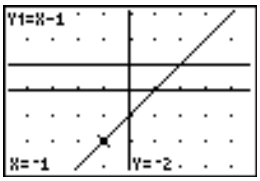
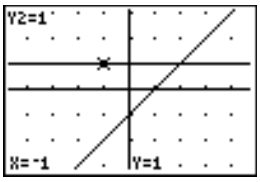
2.5X–1<3



Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73

Solution search using X-Y graphs: Find the solution set for the inequality **X–1<1**. Before you start, estimate the solution using number sense. Write your estimate here. _____

To Do This	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	[2nd] [QUIT] ⟨**EXIT**⟩ [CLEAR]	
2. Set your window format as shown. **Note:** See TIp™ 5: *Adjusting the Viewing Window* for more information.	TI-83: [2nd] [FORMAT] [▼] [▼] [▶] [ENTER] TI-73: [2nd] [FORMAT] [▼] [▶] [ENTER]	
3. Enter both sides of the inequality into the Y= editor as shown. **Note**: On the TI-73, use [x] rather than [X,T,Θ,n]. **Note**: You may need to deselect the other Y= functions. See TIp™ 3: *Graphing a Function in the Standard Window*.	[Y=] [CLEAR] [X,T,Θ,n] [−] **1** [▼] [CLEAR] **1**	
4. Select **ZDecimal** to set the viewing window and graph the functions.	TI-83: [ZOOM] **4:ZDecimal** TI-73: [ZOOM] **8:ZDecimal**	
5. Trace the functions. **Note**: The function displays in the upper left corner of the screen; the **X** and **Y** values are displayed on the bottom of the screen.	[TRACE] [◀] or [▶] to trace a function [▲] and [▼] to move between functions	
6. Compare **Y1** and **Y2** for the same **X** values. For example, notice that when **X = -1**, **Y1= -2** and **Y2=1** as shown on the screens. Where is **X –1 < 1**? _____ **Hint**: Trace **Y1** to find out when **Y1< Y2**. 7. Why? _____ _____ _____		 

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Additional Problems

Solution Search: On the following problems, first estimate the solution using number sense. Then search for the solution set for each inequality using graphs as shown in the previous example. Finally, draw your graphs from your calculator and show your work.

Don't forget to set an appropriate viewing window in order to see your graphs.

Note: See TIp™ 5: *Adjusting the Viewing Window* for more information.

1. **2X+3** $\leq$ **7**

2. **X+4** $>$ **-3**

3. **0.5X−1** $<$ **2**

4. **X−2** $\geq$ **-3**

Linear Inequalities: Using Graphs & Tables — Teacher Notes

Objectives

- To illustrate how to estimate the solution set, in the real numbers, of a linear inequality using graphical methods on a number line and on a Cartesian (x-y) graph.
- To illustrate how to estimate the solution set, in the real numbers, of a linear inequality using tables.

Math Highlights

In the number line method, students use a guess-and-test approach to search for the solution on a number line. A point is chosen to test, the substitution is shown and students see whether the statement is true or false. A point is plotted for a true statement. Students see an estimate of the solution set built on the number line.

In the table of values method, students see a table of values for each side of the inequality. They see where the inequality is satisfied, and then they see how to refine the estimate of the solution set.

In the x-y graphical method, students plot both sides of the inequality and use the graph to determine the solution set for the inequality by testing points. In the 2-D graph, students are able to see which graph is higher or lower than the other graph. This helps them estimate the solution set.

Note: The inequalities of the form $ax + b < c$ (for $<, \leq, >, \geq$) with $a < 0$ are not discussed in this section.

Common Student Errors

- Using graphs and tables can mislead students. They may think that they can always find the exact solution using graphs and table. Although they will often find exact solutions using these methods, using algebra will always give exact solutions for inequalities. For the calculator example, $x + 2 \leq 1$, only integer values are tested. If the example had been $x + 2 < 1$, the students would need to test points closer and closer to $x = -1$ to see that the solution set contains values strictly less than -1. The endpoint (-1) is not included in the solution. Encourage students to pick many points. Remind them that they would have to test **all** points with these methods to get the exact solution, in the real numbers and that is physically impossible to test **all** points!
- At times, introducing the algebraic solution of inequalities gives students just the mechanics of doing a problem. Algebraic methods alone usually do not invite students to reason out the solution using number sense. The graphs and tables method gives students the opportunity to see the values of each side of the inequality as a graph or table so they can compare the size of the numbers, thus helping them create the solution set.
- Visual learners can benefit by seeing the graphs and numbers and using them as the tool to find the solution set.
- Some students may still have difficulty remembering the meaning of the symbols, **<**, **≤**, **>**, and **≥**.

Student Worksheet Notes with Answers

Overview

Tell students:

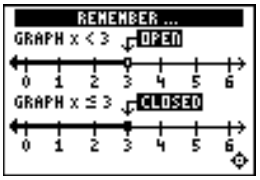
1. How to find the **Overview**, or tell them to review the instructions on the worksheet.
2. How to navigate the application, if they are not yet familiar with the application.
3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

Observations

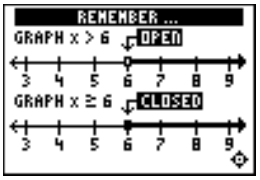
The **Observations** help students understand concepts about linear inequalities relating to graphs and tables. If necessary, tell students how to find the **Observations**.



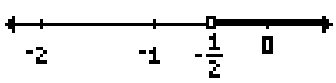
Observation 1



1. **x < 3**
2. **x ≤ 3**

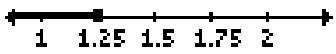


3. **x > 6**
4. **x ≥ 6**



5. **$x > -\frac{1}{2}$**

(Not in the Topics in Algebra 1 application.)



6. **x ≤ 1.25**

(Not in the Topics in Algebra 1 application.)

Activities



Scoring: There are five problems in each set. Students get two attempts to solve for **x** for each problem. You get 2 points for a correct choice on the first try, and 1 point for a correct choice on the second try.

Students can earn up to 10 points.

Build the Solution Set!

Tell students to:

1. Use ◄ or ► to move the cursor along the number line. Press ENTER to select the first point to test. The point is displayed along with the result of the test.
2. Choose another point to test. After the point and result of the test for the second point are displayed, four possible solutions for **x** are displayed.
3. Press ◄ or ► to highlight the correct solution, and then press ENTER to select it. If students choose an incorrect solution on the first try, they get another try. If they choose an incorrect solution on the second try, the correct answer is displayed. Students can press any key to go to the next problem. As they play the activity, they should write the inequalities and their solutions.
4. Record their scores.



Note: Students can press ◄ or ► to leave this screen.

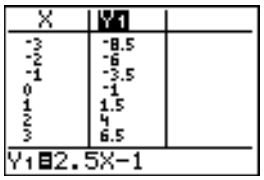
Worksheet Activity 1

Tell students to:

1. Use number sense to estimate the solution set for the following three inequalities on the number lines provided.
2. Place the appropriate scale on each number line so that they are able to show the solution set appropriately.
3. Check several points as shown in the activity above.
4. Show all of their work.

1. $x + 2.5 < 7$ *when* $x < 4.5$
2. $x - 3.6 \leq -2$ *when* $x \leq 1.6$
3. $x + \frac{3}{4} > 4\frac{1}{8}$ *when* $x > 3\frac{3}{8}$

Activities (continued)



Worksheet Activity 2

Tell students to:

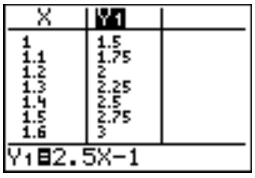
Use the table of the expression **2.5X–1** shown on their worksheets (shown at left) to find out when **2.5X–1<3** by first estimating the answer, and then using number sense to determine the exact answer. Remind them to write their strategy for the solution and to draw the solution set on a number line.

From the table, students should see that they need to test more values between **X=1** *and* **X=2** *to find where* **2.5X–1<3**.

If you wish the students to continue the activity on their calculators, tell them to enter the function in the Y= editor. Then on the **TABLE SETUP** *screen (*2nd [TBLSET]*), they can refine their search as shown in the screens below.*

The students see that **2.5X–1** *is equal to* **3** *at* **X=1.6**, *but they need to figure out when* **2.5X–1< 3**. *Students can go to the* **TABLE SETUP** *screen and change the settings to* **TblStart=1** *and* **ΔTbl=.1**, *and then investigate further. This problem should be discussed to show that the search should still continue because the endpoint of* **1.6** *is not in the solution set. The answer is* **X<1.6**. *To investigate further, refine the table values by changing* **TblStart=1.5**, *and* **ΔTbl=.01.**



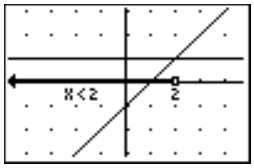


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Solution Search Using X-Y Graphs: Tell students to first estimate the solution for the inequality **X–1<1** using number sense and then find the solution set using a calculator.

6. **X–1 < 1** *when* **X< 2**.

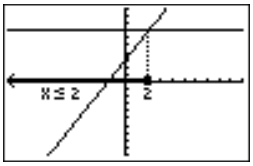
7. *Answers may vary*. Students can trace the graph to see the result.



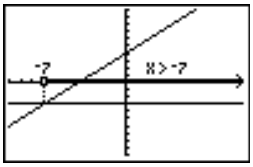
Additional Problems

Students investigate inequalities using **X-Y** *graphs to compare numbers in order to create the solution set. See the student worksheet for calculator details. Students must set appropriate graphing windows in order to see the graphs. Graphing windows shown use* ZOOM **ZStandard**, *which sets* **X** *and* **Y** *values so that* **-10** ≤ *value* ≤ **10**.

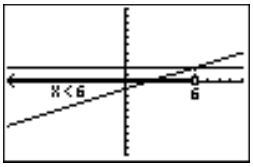
1. **2X+3** ≤ **7**



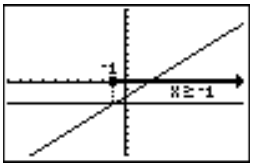
2. **X+4** > **-3**



3. **0.5X−1** < **2**



4. **X−2** ≥ **-3**



Name _____
Date _____

Linear Inequalities: Using Algebra — Student Worksheet

Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

Observations

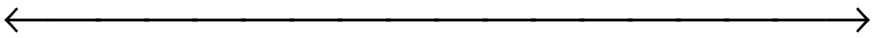
The **Observations** illustrate mathematical concepts relating to using algebra in linear inequalities. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



Observation

Solve the inequality. Show your work.

Draw the solution set on the number line.



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Name _____
Date _____

Activities

The **Activities** help you practice using algebra to solve inequalities. You can select from two different activities—**Solve It!** and **Free Fall**. Follow these steps to play the activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.

2. Highlight an activity using ▲ or ▼, and press ENTER.



Scoring: You get two attempts to pick the step. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try. You get an additional 2 points for the correct solution.

The total number of points available varies.

Solve It!

1. Highlight a level (silver = less difficult; gold = more difficult), and press ENTER to select it.

2. Look at the algebraic expression at the top of the screen and decide what must be done to solve the inequality for **x**.

3. Press ▼ or ▲ to cycle through steps to choose from, and then press ENTER to select the correct step (some problems require two steps). If your second choice is incorrect, the correct step is displayed; press any key to continue play. If the activity prompts you to select the correct result, highlight it with ▶ or ◀, and then press ENTER to select it. As you play the activity, write each inequality. What was your strategy for finding the solution?

4. What level did you play? _____

5. What was your score? _____

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Name _____
Date _____

Activities (continued)



Scoring: Points are based on how quickly you solve each equation.

Unless you specify point or time limits for this activity, students can play the activity when four missed equations stack up, the game is over.or they press ⟨**QUIT**⟩ to stop. There is no time limit.

Free Fall

1. Highlight a level (silver = less difficult; gold = more difficult), and press [ENTER] to select it.
2. When you are ready to start, press any key.
3. Watch the equation as it falls, and quickly solve for **x**. Enter the solution (press [(-)] for negative numbers), and press [ENTER] before the equation hits bottom. If you give an incorrect answer, the correct answer is displayed; press any key to resume play. The incorrect equation stacks up at the bottom of the screen, giving you less time to solve the next equation.
4. Follow your teacher's instructions for how long to play the activity.
5. What level did you play? _____
6. What was your score? _____

Additional Problems

Solve the following inequalities. Show your work.

1. $6.4x > 16$

2. $\frac{1}{2}x - 2 \leq -2$

3. $2x - 2.1 < -3.5$

4. A cell phone company charges a flat fee of \$15 per month to use the phone. They also charge 25 cents for each phone call you make no matter how long you are on the phone. Your budget allows you to spend at most \$30 per month for the phone. How many phone calls will you be able to make each month? (Tax is included in the prices.) Show your work. Write a short paragraph explaining why would you choose this company or why not.

Name _____
Date _____

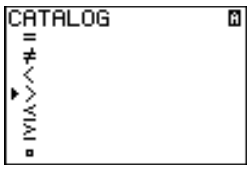
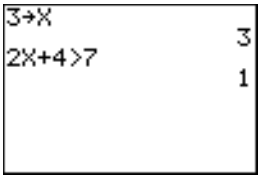
Try-It!™ on Your TI-83 Plus or TI-73

Testing points and graphing solution sets: If **X=3**, is **2X+4>7** true or false? Try it by hand first. Show your work below.

To Do This	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. From the Home screen, the calculator can tell you if a sentence is TRUE or FALSE (**1**=TRUE and **0**=FALSE).		
3. First, check what value is currently stored in **X**. **Note**: On the TI-73, use x rather than X,T,Θ,*n*.	X,T,Θ,*n* ENTER	

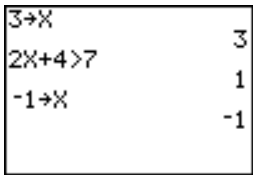
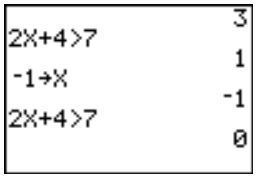
4. What is the value of **X** stored in your calculator? _____

 Check around the class. Most likely, there are many different values of **X**.

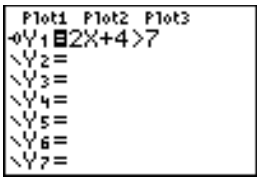
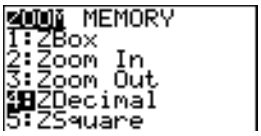
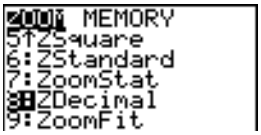
5. First, if you want to find out if **2X+4 > 7** is true or false when **X=3**, you must tell the calculator that **X=3**, which is called storing a value in **X**. **Note**: On the TI-73, use x rather than X,T,Θ,*n*.	CLEAR **3** STO▶ X,T,Θ,*n* ENTER	
6. Next, input the number sentence **2X+4>7.** This takes two steps. **Note**: On the TI-73, use x rather than X,T,Θ,*n*.	**2** X,T,Θ,*n* + **4**	
7. You can find the **>** (greater than) sign in the catalog (2nd [CATALOG]). **Shortcuts:** On the TI-83 Plus, press 2nd [TEST] **3**. On the TI-73, press 2nd [TEXT] ▼ ▼ ▼ ▶ ▶ ENTER to select **>** and ▼ ENTER to select **Done**.	2nd [CATALOG] ▲ until the cursor is next to **>** ENTER	
8. Now, complete the sentence and see the result! Remember, **1**=TRUE and **0**=FALSE. If you substitute **X=3**, you get **10>7** which is TRUE.	**7** ENTER	

Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

To Do This	Press	Display (TI-83 Plus shown)
9. Test another point! (Try **-1**.) **Note**: On the TI-73, use [x] rather than [X,T,Θ,n].	(-) **1** [STO▶] [X,T,Θ,n] [ENTER]	
10. You do not have to type in the number sentence **2X+4>7** again. **Note:** You also can edit an expression after it is pasted to the line. Since **1**=TRUE and **0**=FALSE, **2X+4>7** is FALSE when **X=-1**.	TI-83 Plus: [2nd] [ENTRY] [2nd] [ENTRY] [ENTER] TI-73: [▲] [▲] [▲] [▲] to highlight expression [ENTER] to copy [ENTER]	

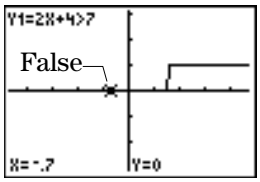
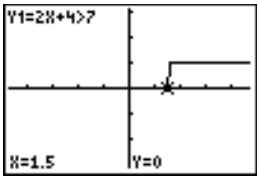
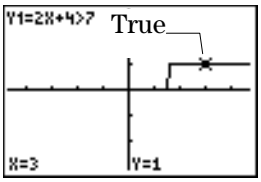
Graph the inequality **2X + 4 > 7**.

To Do This	Press	Display (TI-83 Plus shown)
1. Graph this solution set. **Note**: On the TI-73, use [x] rather than [X,T,Θ,n].	[Y=] [CLEAR] **2** [X,T,Θ,n] [+] **4** [2nd] [CATALOG] [▲] until the cursor is next to **>** [ENTER] **7**	
2. Set the graph style to the animate graph style, which lets you see the graph as it is being plotted, even when it is on the axis at **Y=0**.	[◀] until the cursor is in the left column [ENTER] until the style is indicated	
3. Set the viewing window and graph the inequality by selecting **ZDecimal**.	TI-83 Plus: [ZOOM] **4:ZDecimal** TI-73: [ZOOM] **8:ZDecimal**	 

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Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

To Do This	Press	Display (TI-83 Plus shown)
4. Trace the function. Notice that where the graph is FALSE, **Y1=0**; where the graph is TRUE, **Y1=1**.	TRACE ◄ or ► to trace the function	
5. Notice that **Y1=0** (FALSE) up through **X=1.5** (when **X≤1.5**).	◄ or ► to trace the function	
6. Keep tracing and you see that the graph jumps to **Y1=1** (TRUE) when **X>1.5**. Find the exact set using algebra. Solve **2X+4>7**. Does your answer agree with this graph?	◄ or ► to trace the function	

Additional Problems

Above, you solved the following inequalities using algebra. Now, graph the solution set of these inequalities using your calculator. Compare the graph to your calculated answers above.

1. **6.4X>16**

2. $\frac{1}{2}X-2\leq -2$

3. **2X−2.1<−3.5**

Linear Inequalities: Using Algebra Teacher Notes

Objectives

- To review one-step and two-step linear inequalities.
- To review the Properties of Inequalities.

Math Highlights

This section opens with examples of solving linear inequalities of the forms, $x + a < b$, $ax < b$, and $ax + b < c$ for any relation $<$, $\leq$, $>$, and $\geq$. Word problems about an amusement park are included for students to solve. The students also see the need to interpret the answers obtained using the appropriate number set. For example, they find that they have to knock down at least 9 3/8 bottles to earn enough points for the best prize. They see that they need to interpret this answer as at least 10 bottles in order to win the prize.

The inequality properties of addition, subtraction, multiplication and division are given. When multiplying or dividing by a negative number, students are reminded about the reversal of the inequality sign. They also are reminded of how to translate phrases such as "at least" and "at most" to the appropriate relation in the **Observations** subsection.

Common Student Errors

- Students may have a hard time deciding which steps to follow to solve the inequality. They should connect this work back to the methods of solving linear equations. Students might make sign errors as they add or subtract from both sides of the inequality or reverse the inequality when multiplying or dividing by a negative number.
- Students may have difficulty making the connection that $C > 0$ means C is positive and $C < 0$ means C is negative.
- Although this section deals with the mechanical way of finding the solution set, students should be reminded that they should check to see if the solution set is reasonable. They need to keep using number sense.
- Many students are able to find the answer using number sense without the written work. Learning how to write mathematics correctly is part of the communication skill and needs to be encouraged. This can cause frustration for students who find the problems easy to solve "in their heads."
- Some students have difficulty remembering the meaning of the symbols, $<$, $\leq$, $>$, and $\geq$. They also have trouble translating the phrases such as "at least" and "at most."

Student Worksheet Notes with Answers

Overview

Tell students:

1. How to find the **Overview**, or tell them to review the instructions on the worksheet.
2. How to navigate the application, if they are not yet familiar with the application.
3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

Observations

The **Observations** give students an opportunity to practice finding the solution set to given inequalities. They are reminded about reversing the inequality sign when multiplying or dividing an inequality by a negative number. They also see a reminder of how to translate a phrase such as *more than* to the symbol >.

If necessary, tell students how to find the **Observations** for this section.



Observation 1

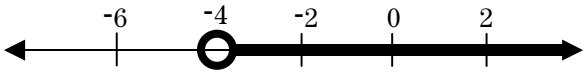
Solve for **x**:
-2x+3 <11

x>-4.

Students will see the answers on the next screen. Students' work may vary with the step order shown on the screen.



Students label the result on a number line. A possible number line looks like this:



Activities



Scoring: Students get two attempts to solve each problem. They earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try. They get an additional 2 points for the correct solution.

The total number of points available varies.

Solve It!

Tell students to:

1. Highlight a level (silver = less difficult; gold = more difficult), and press ENTER to select it.
2. Look at the algebraic expression at the top of the screen and decide what must be done to solve the inequality for **x**. Students must select from the choices offered; this activity presents only one sequence of steps (to first isolate **x** and then change the coefficient of **x** to 1), although other sequences may be correct.
3. Press ▼ or ▲ to cycle through steps to choose from, and then press ENTER to select the correct step (some problems require two steps). If their second choice is incorrect, the correct step is displayed; press any key to continue play. If the activity prompts them to select the correct result, highlight it with ▶ or ◀, and then press ENTER to select it. As they play the activity, write each inequality and their strategy for finding the solution.
4. Record the level they played.
5. Record their scores.



Scoring: Points are based on how quickly students solve each equation. If they give an incorrect answer, the equation stacks up at the bottom of the screen, giving them less time to solve the next equation.

Unless you specify point or time limits for this activity, students can play the activity when four missed equations stack up, the game is over.or they press 〈**QUIT**〉 to stop. There is no time limit.

Free Fall

Tell students to:

1. Highlight a level (silver = less difficult; gold = more difficult), and press ENTER to select it.
2. When they are ready to start, press any key.
3. Watch the equation as it falls, and quickly solve for **x**. Enter the solution (press (-) for negative numbers), and press ENTER before the equation hits bottom. If they give an incorrect answer, the correct answer is displayed; press any key to resume play.
4. Follow your instructions. For example, students can play:
 - Until they have answered incorrectly four times (no time limit).
 - Until a certain amount of time has expired (highest score with the fewest misses wins).
 - Until a certain score has been reached (first student to reach the score with the fewest misses wins).
 - Repeatedly over a period of time (days, weeks, etc.) for tracking improvement of high scores.
5. Record the level they played.
6. Record their scores.

Activities (continued)

Additional Problems

1. $6.4x > 16$ *when* $x > 2.5$

2. $\frac{1}{2}x - 2 \leq -2$ *when* $x \leq 0$

3. $2x - 2.1 < -3.5$ *when* $x < -0.7$

4. Let C = the number of phone calls per month. Therefore, $15 + 0.25C \leq 30$. The solution is $C \leq 60$. Students could discuss that this is about 2 calls per day. They should write whether or not this phone plan would be adequate for them.

Try-It!™ on Your TI-83 Plus or TI-73

This keystroke exercise lets students learn about the logic functionality built in the calculator. They see how to store a variable, test an inequality and finally graph a TRUE(**1**)/FALSE(**0**) graph. By graphing the solution set using the calculator's logic, they can verify their algebraic work on the inequalities.

Students first solve the problem by hand. They should show all their work.

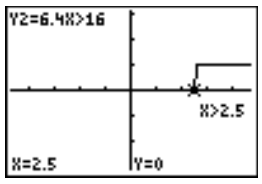
If **X=3**, is **2X+4>7** true or false?
Answer: $2(3) + 4 > 7$
$6 + 4 > 7$
$10 > 7$
Therefore, the statement is true.

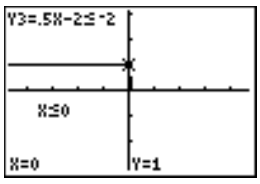
Tell students to follow the steps exactly on the calculators. Example screens are displayed on the worksheets for students to compare with the calculator screens.

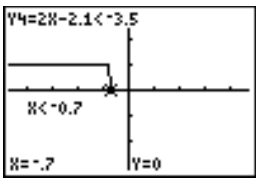
Additional Problems

Tell students to do the following calculation by hand, and then check the answers using the calculator. They should show all their work.

The graphs are shown below using **ZDecimal** (ZOOM) window values. Students should discuss how they determine the endpoint of the solution set. Remind them that using algebra gives the exact answer. The graph helps them see where the solution is approximately located.

1. 

2. 

3. 

Name _____
Date _____

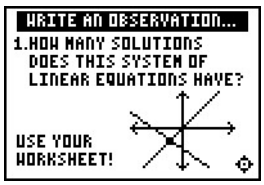
Linear Systems: Using Graphs & Tables — Student Worksheet

Overview

The **Overview** introduces topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

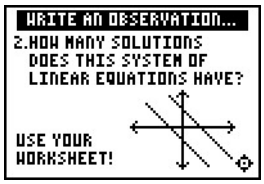
Observations

The **Observations** illustrate that two lines in a plane intersect, are parallel or are the same line. By graphing the lines of a system of two linear equations with two variables, you can determine the possible number of solutions. Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answer to the question on your worksheet.



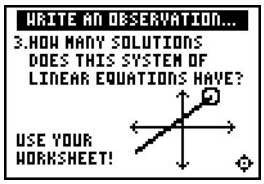
Observation 1

How many solutions does this system of linear equations have?



Observation 2

How many solutions does this system of linear equations have?



Observation 3

How many solutions does this system of linear equations have?

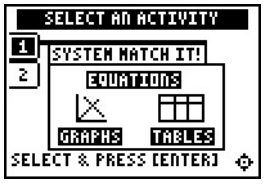
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Name _____
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Activities

The **Activities** help you practice using graphs and tables. You can select from two different activities—**System Match It!** and a worksheet activity. Follow these steps to play the activities and complete your worksheet.

1. Make sure you are in the **Activities** for this section.
2. Highlight an activity using ▲ or ▼, and press ENTER.



Scoring: You get one attempt to answer the problem. You earn 2 points for a correct answer. You can earn up to 12 points.

Tip: Be careful! The graphs may appear close together.

System Match It!

1. Select the correct answer to the question. Questions include:
 - Selecting the graph that correctly illustrates the system.
 - Selecting the system that correctly describes a graph.
 - Selecting the correct solution of a system given a table.
2. What was your score?



Notes: See TIp™ 4: Creating a Table to help you with tables.

See also Try-It!™ in Chapter 2 Sections 1 and 2 for working with tables and linear equations.

Worksheet Activity

Solve a system using tables.

a. Blue Lake is Pat's favorite place to swim during the summer. There is an entry fee of $12.00 per car per day. Pat notices a sign as they approach the entrance. His family could join the Blue Lake Club for the summer! It costs $48.00 to join and then the entry fee becomes $6.00 per car per day. Fill in the table to help you develop the equations.

Days at the Lake	Cost Without Membership	Cost With Membership
1	$12(1) = $12	$48 + $6(1) = $54
2	$12(2) = $24	$48 + $6(2) = $60
3		
4		
…	…	…
D		

b. Let C = the entry cost to the lake. Let D = the number of days Pat's family goes to the lake during one summer. Write the system of two equations that describe the cost of the entry fee without membership and with membership. Use the table above (in part a) to help you write the equations.

Cost Without Membership: _____

Cost With Membership: _____

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Name _____

Date _____

Activities (continued)

c. Check that the equations are written in slope-intercept form, $y = mx + b$. This prepares you to enter the system into your calculator. You will also have to change the variable. Notice that the cost, C, is the dependent variable (Y) and the number of days, D, is the independent variable (X). Write the equations so you can enter them in your calculator.

Y1= _____

Y2= _____

d. Use a table to find the cost of the entry to the lake with and without membership. When is the entry cost without membership equal to the entry cost with membership?

e. If Pat's family goes to the lake 6 times this summer, should they join the Blue Lake Club to save money? Why?

f. If Pat's family goes to the lake 10 times this summer, should they join the Blue Lake Club to save money? Why?

Challenge: Learn how to take a picture of a screen on your calculator using TI Connect™ software or TI-GRAPH LINK™ software and cable. You can paste a screen into a word processor and then print it out to hand in for your homework! Go to http://education.ti.com and search for TI Connect or TI-GRAPH LINK.

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Try-It!™ on Your TI-83 Plus or TI-73

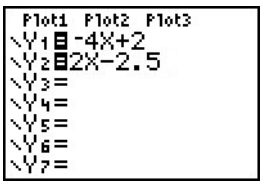
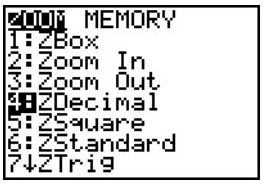
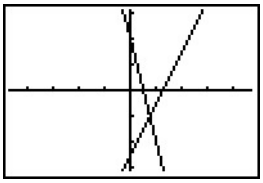
You will:

- Graph two lines of a system of equations.
- Use [TRACE] to locate the intersection of the lines.
- Use [2nd] [TABLE] and [2nd] [TBLSET] to locate the exact solution of the system of equations.

Find the solution of the system: $Y1 = -4X + 2$

$Y2 = 2X - 2.5$

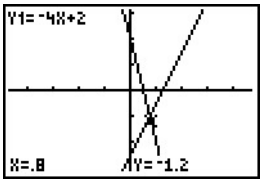
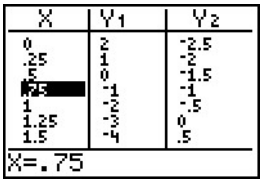
Notice that these equations are already in the form of y = mx + b. They are in the form to enter into your calculator.

To Do This	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	[2nd] [QUIT] ⟨**EXIT**⟩ [CLEAR]	
2. First, enter **$-4X + 2$** as Y1 and **$2X - 2.5$** as Y2 in the Y= editor. **Note:** See TIp™ 3: Graphing a Function in the Standard Window for more information. **Note:** On the TI-73, use [x] rather than [X,T,Θ,n].	[Y=] [CLEAR] [(-)] **4** [X,T,Θ,n] [+] **2** [▼] [CLEAR] **2** [X,T,Θ,n] [−] **2** [.] **5**	
3. Select the Zoom Decimal viewing window. The graph displays. **Remember:** You have to adjust the viewing window depending on the system of equations. You can see the intersection of the lines in the ZDecimal window for this example.	TI-83 Plus: [ZOOM] **4:ZDecimal** TI-73: [ZOOM] **8:ZDecimal**	 

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Name _____
Date _____

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

To Do This	Press	Display (TI-83 Plus shown)
4. Trace close to the intersection of the graphs to find a value close to the solution. Since Zoom Decimal traces by tenths, you can get close to the answer but this is not the exact answer. Notice that the point (0.8, ⁻1.2) on the screen is on Y1. Is this point on Y2? Check it out! For this particular calculator setup, you don't get the exact answer. Read on to see how to refine the answer.	[TRACE] [▲], [▼], [▶], or [◀]	
5. Use the table setup to refine the solution. Set up your table to show values close to X = 0.8. As shown here, you can use a starting value of 0 with increments of 0.25.	[2nd] [TBLSET] [CLEAR] **0** [▼] **0.25** [CLEAR]	
6. Search through the table to see that the lines intersect at (0.75, ⁻1). Notice that both Y1 and Y2 are ⁻1 when X = 0.75. Verify by hand that the solution is (X, Y) = (0.75, ⁻1). You also know that there is only one solution because the lines intersect at one point, so your search is complete.	[2nd] [TABLE]	

Note: Learn more about the calculator features **intersect** and **Solver** in the Try-It!™ section in Chapter 5: Linear Systems, Section 2: Using Algebra.

Name _____

Date _____

Solution Search

Write the solution and explain how you found the solution using graphs and a table for each of the problems below. Do the following for each problem.

- Rewrite the system in slope-intercept form, $y = mx + b$, if necessary.
- Use the slope-intercept form of the equations to draw a rough sketch of the lines. You can verify your graph on your calculator. Estimate the solution so that you have an idea of how many solutions there are and where the solution is located.
- Search for the solution of the equation on the calculator using graphs and a table.
- See TIp™ 4: Creating a Table and TIp 5: Adjusting the Viewing Window for additional help with the calculator.
- Remember to change your viewing window (WINDOW) or your table setting (2nd [TBLSET]) to do your search.
- Explain how you found the solution.
- Write out how you checked the solution.

Remember: The TI-73 and the TI-83 Plus only use the variables X and Y for graphs and tables. If an equation uses letters other than X and Y, you have to change the variables in the problem to X and Y on the TI-73 and the TI-83 Plus. Use parentheses, if needed, when entering the equations in the Y= editor.

1. $y = 2x + 4$
 $3x + y = -11$

2. $-x + 3y = 4$
 $\frac{1}{3}x + y = \frac{10}{3}$

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Name _____
Date _____

Solution Search (continued)

3. $2w + t = 35$
 $\frac{-2}{5}w + \frac{1}{5}t = 19$

4. $4x + 7y = 8$
 $4x + 7y = 14$

5. $x - 9y = 7$
 $2x - 18y = 14$

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Linear Systems: Using Graphs & Tables — Teacher Notes

Objectives

- To illustrate how to locate the real number solution of a system of linear equations (two equations and two variables) using tables.
- To illustrate how to locate the real number solution of a system of linear equations (two equations and two variables) using graphs.
- To graphically illustrate the types of solutions expected for a system of linear equations.

Math Highlights

Students work with a system of linear equations that has two equations in two variables. They begin the **Overview** by setting up an analysis of two different cell phone plans. The two plans can be modeled by linear equations. They investigate when the two plans cost the same amount of money.

In the table of values example, students see a table of values for each equation. To create the table, the equations are in the form y = mx + b. They see that the x value that gives the same y value for both equations is the solution. They also see that they may need to refine the table of values to search for the solution.

In the x-y graphical example, students graph both equations and locate the intersection of the lines. The (x,y) coordinate of the intersection of the lines is the solution. Since the graphs of the linear equations in the system can intersect, be parallel, or be the same line, students also see that they may find a unique solution, no solution, or an infinite number of solutions to the system.

In **Observations**, students associate the graphs of the lines of a system with the number of solutions of the system. This is covered again at a higher level in Section 2: Using Algebra.

Common Student Errors

- Students have to rewrite the system in slope-intercept form in order to enter the equations into the calculator. Many students tend to make sign errors and division errors when they rewrite equations. For example, given 2T + 3S = 57 students would first have to rewrite the equation as S = (⁻2/3)T + (57/3), assuming S is the dependent variable. Then, the students have to rewrite this equation as Y1 = (⁻2/3)X + (57/3). A common division error is to write the equation as Y1 = (⁻2/3)X + 57, which is incorrect.
- Students forget to enter fractions into the Y= editor using parentheses. Remind students about the order of operation. If they enter ⁻2/3X, the calculator interprets this as ⁻2 ÷ (3 × X) following the order of operation rules. The correct entry is (⁻2/3) × X.

 Note: TI-73 users can use [b/c] to enter the fractions. However, you should still remind them how to use parentheses and about the order of operation rules.
- When solving by graphing using the graphing calculator, some students trace along one function to what appears to be the intersection point without verifying that that point is also on the other line.

Common Student Errors (continued)

- After students have practiced using graphs and tables to solve a system of equations, they may think that they can always find the exact solution for a system using these methods. Although they can often find exact solutions using these methods, using algebra always gives exact answers for these equations. To help them understand this idea, have students try to search for the solution to the system $y = 2x + 3$ and $y = 2x + 4$. Using a table, they could search forever since these lines are parallel. Using a graph, they might think that the lines are parallel, but they are only looking at a few viewing windows. Ask them how they can know if there is a window where the lines intersect. Open a discussion with your class to see if they think they can verify that this system has no solution using tables or graphs.
- Algebraic methods alone usually do not invite the student to reason out the solution using their knowledge of number sense and geometry. Many students learn the mechanics of solving a problem without understanding the problem or the solution. The graphs and tables method gives students the opportunity to see the values and graphs of the equations so they can see when two equations have the same value.
 Ask students to look at the equations $y = 2x + 3$ and $y = 2x + 4$ again, and use their number sense. Ask them if $2x + 3$ could ever be the same value as $2x + 4$ for a given x? Encourage students to first look at the equations to see if their knowledge of geometry or their number sense can tell them something about the system before they start their method of solution.
- Some visual learners benefit by seeing the numbers and graphs first, and then by using these as the tool to find the solution. However, many students can see the solution to some systems using their number sense. These students may have difficulty taking the time to show and write about their work. This may also be an issue in Chapter 5: Linear Systems, Section 2: Using Algebra. Encourage student to use written mathematics as well as drawing graphs and tables as a communication tool. Have students look in newspapers and on the web for graphs and tables of information to show real examples for the need for this communication skill.

 Require students to write out complete solutions to problems, including the mathematics and the interpretation of what the numbers mean in the problem. For example, the cell phone problem in the **Overview** subsection requires not only the numeric answer but also an explanation about what the numbers mean with respect to the cell phone users.

Student Worksheet Notes with Answers

Overview

Tell students:

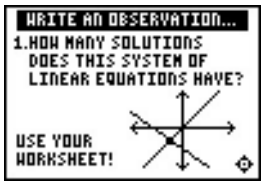
1. How to find the **Overview**, if necessary.
2. How to navigate the application, if necessary.
3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

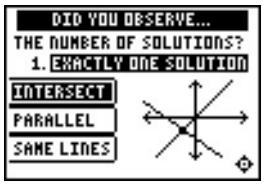
Observations

The **Observations** help students start to uncover the types of solutions that arise in systems of linear equations. If necessary, tell students how to find the **Observations** section.

Students are asked to observe the number of solutions from the given graph. They should question whether they are seeing enough of the graph to make a conjecture about the number of solutions.

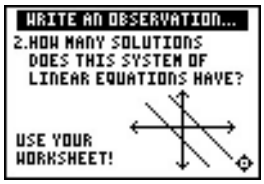
Observation 1

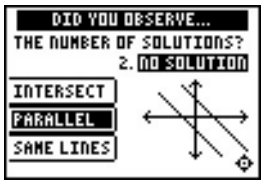




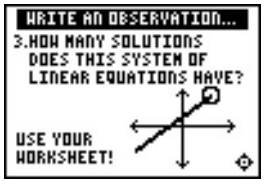
Students see the answer after the third observation question.

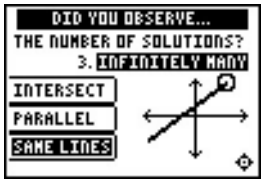
Observation 2





Observation 3





Activities



Scoring: You get two attempts to answer the problem. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try. You can earn up to 12 points.

System Match It!

Tell students to:

1. Select the correct answer to the question. Questions include:
 - Selecting the graph that correctly illustrates the system.
 - Selecting the system that correctly describes a graph.
 - Selecting the correct solution of a system given a table.
2. Record their scores.

Remind students that the graphs might appear very close together on the screen. They need to use their knowledge about both the functions and the graph to determine the correct answer.



Notes: See TIps™ 4: Creating a Table to help you with tables.

See Try-It!™ in Chapter 2 Sections 1 and 2 for working with tables and linear equations.

Worksheet Activity

Students investigate the entry fee to Blue Lake. They compare the entry fees with and without a membership fee.

a. Students should gather information from the problem to write a system of equations for the investigation. Filling in the table with all of the calculations written out helps students develop the equations inductively.

Days at the Lake	Cost Without Membership	Cost With Membership
1	\$12(1) = \$12	\$48 + \$6(1) = \$54
2	\$12(2) = \$24	\$48 + \$6(2) = \$60
3	\$12(3) = \$36	\$48 + \$6(3) = \$66
4	\$12(4) = \$48	\$48 + \$6(2) = \$72
…	…	…
D	12D	48 + 6D

b. Variables are suggested. Review the concept of independent and dependent variables with the students.

Let C = the entry cost to the lake.
Let D = the number of days Pat's family goes to the lake during one summer.

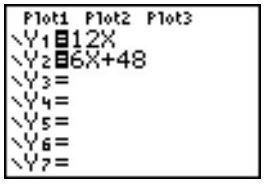
C = 12D
C = 6D + 48 (Students could also enter 48 + 6D.)

Activities (continued)

c. Rewrite the problem in terms of Y1, Y2 and X to prepare to enter the system into the Y= editor.

Y1 = 12X —or— Y1 = 6X + 48
Y2 = 6X + 48 Y2 = 12X

The independent variable (days at the lake) and the dependent variable (entry cost) are stated in the problem. Remind students that the calculator treats X as the independent variable and Y as the dependent variable.



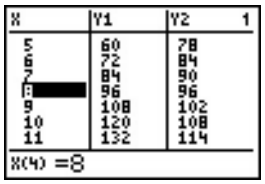
Enter equations in Y= editor.

d. Students need to enter the equations in the Y= editor and should set up the table. Discuss that the domain of the system should be whole numbers starting at 0 since x counts the number of trips to the lake. Notice at x = 8, Y1 = Y2 which is the breakeven point. If Pat's family goes to the lake up to and including 8 times, they might not choose to join the Blue Lake club.



Set up the table.

e. If Pat's family goes to the lake only 6 times during the summer, they will spend more money if they join the club for $48.



Search for where the equations are equal.

f. If Pat's family goes to the lake 10 times during the summer, they will save money if they join the club. They will save $120 – $108 = $16. Discuss the savings if the family goes to the lake more than 10 times. Pose questions such as, when will they save $50?

Have students find other situations that set fees in this manner. One source is the national and state park services web pages.

Try-It!™ on Your TI-83 Plus or TI-73

Students search for the solution of a system of two linear equations in two variables using graphing and tracing, and a table. The problem has been chosen so that students do not trace to the exact solution and need to use the table to search. They could also choose to change the window so that they could trace to the exact solution. This is not an efficient choice, but could be pursued, and the investigation would be enriching.

The students will:

- Graph two lines of a system of equations.
- Use [TRACE] to locate the intersection of the lines.
- Use [2nd] [TBLSET] and [2nd] [TABLE] to locate the exact solution of the system of equations.

Note: Students will learn more about the calculator features intersect (TI-83 Plus) and Solver (TI-83 Plus and TI-73) in the Try-It! section in Chapter 5: Linear Systems, Section 2: Using Algebra.

Tell students to follow the steps exactly on the calculators. Example screens are displayed on the worksheets for students to compare with the calculator screens.

Solution Search

Tell students to:

- Rewrite the system in slope-intercept form, y = mx + b, if necessary.
- Use the slope-intercept form of the equations to draw a rough sketch of the lines. Verify the graphs on the calculator. Estimate the solution so they have an idea of how many solutions there are and where the solution is located.
- Search for the solution of the equation on the calculator using graphs and a table.

 Notes: Since the calculator only uses the variables X and Y for graphs, tables and some other features, students must decide which variable in the problem should be X and which one should be Y when the problem uses other variables. Discuss independent and dependent variables, emphasizing that the calculator is set up to treat X as the independent variable and Y as the dependent variable.

 Remind students to use parentheses correctly when they enter equations into the Y= editor. For example, (1/3)X is not the same as 1/3X which is 1/(3X) when the order of operation rules are applied by the calculator. However, when TI-73 users enter 1/3 using the [b/c] key, their entry is calculated correctly.

 Remind students to change the viewing window ([WINDOW]) or table setting ([2nd] [TBLSET]) to do the search. TIp™ 4: Creating a Table and TIp 5: Adjusting the Viewing Window provide additional help with the calculator.
- Explain how they found the solution.
- Write out the check of their solution.

Answers:

1. (x, y) = (-3, -2)
2. (x, y) = (3, 7/3)
3. (w, t) = (-15, 65) Students are not given which variable is dependent and which is independent. They may very well write the solution as (t, w) = (65, -15).
4. Lines are parallel, which implies that there are no solutions.
5. Lines are the same, which implies that there are an infinite number of solutions.

Name _____
Date _____

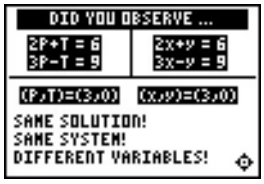
Linear Systems: Using Algebra — Student Worksheet

Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using ▶ (◀ to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

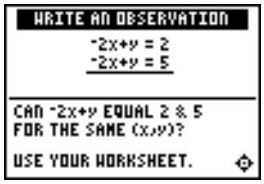
Observations

Scroll through the **Observations** using ▶ (◀ to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.



Observation 1

Find the solution of each system shown on the screen. Use either the substitution or elimination method.



Observation 2

For the system of equations shown on the screen, can the expression $-2x + y$ equal 2 and 5 for the same (x, y)?



Observation 3

Solve the given system using the elimination method.

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Activities

The **Activities** help you practice using algebra to solve linear systems. You can select from two different activities—**What Am I?** and **Balloon Ride**. Follow these steps to play the activities and complete your worksheet.

1. Make sure you are in the **Activities** for this section.
2. Highlight an activity using ▲ or ▼ and press ENTER.



Scoring: You get one attempt to pick the correct classification of the system. You get 2 points for a correct choice and 1 point for a correct choice if you press ⟨HINT⟩ to see the graph.

Four systems are given for a maximum score of 8 points.

What Am I?

1. Highlight a level (silver = less difficult; gold = more difficult), and press ENTER to select it.
2. Look at the system of equations and decide if the system is consistent & independent, consistent & dependent, or inconsistent.

 Press ⟨**HINT**⟩ if you need to see the graph. You only get 1 point for the problem if you press ⟨**HINT**⟩.

 Press ▲ or ▼ to cycle through the choices and then press ENTER to select the correct answer. The correct answer and graph are displayed if the incorrect answer is chosen. You must press a key to continue play.
3. In the space below, write out the algebraic steps (using elimination or substitution) for each problem or explain why you knew the correct answer.
4. What level did you play? _____
5. What was your score? _____

Problem 1:

Problem 2:

Problem 3:

Problem 4:

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Activities (continued)



Scoring: You get two attempts to pick or input the correct solution to the system of equations. You get 2 points for a correct choice or input on the first try, and 1 point for a correct choice or input on the second try.

There are 4 problems for a maximum score of 8 points.

Balloon Ride

1. Highlight a level (silver = less difficult; gold = more difficult), and press [ENTER] to select it.

2. Look at the system of equations and solve using the algebraic methods of substitution or elimination.

 Silver level: Press [▲] or [▼] to cycle through the solutions to choose from, and then press [ENTER] to select the solution. You must press a key to continue play.

 Gold level: Use [▲] or [▼] to select an answer or to get to the input box. Select or input your answer and press [ENTER]. (Press [(-)] to enter negative numbers.) You must press a key to continue play.

3. As you play, write out the algebraic steps (using elimination or substitution) for each problem or explain why you knew the correct answer in the space below.

4. What level did you play? _____

5. What was your score? _____

Problem 1:

Problem 2:

Problem 3:

Problem 4:

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Extra Practice: Using Substitution or Elimination

1. Cathy found a part-time job for the summer. Each week, when she works up to 10 hours, she earns a regular hourly wage. If she works more than 10 hours each week, she earns more money per hour for the overtime hours. She worked 14.5 hours during the first week. Her paycheck, before taxes and deductions, was $93.75. The second week, she worked 12 hours and her paycheck, before taxes and deductions, was $75.00. Cathy's boss had told her what her hourly and overtime rates were, but Cathy was so excited to get the job that she couldn't remember what she was told.

 - Write a system of equations for Cathy's hourly and overtime pay rates. Clearly define the variables and their meanings.

 - Solve the system of equations using substitution. Show your work and explain the steps you used to solve the system of equations. Show the check of your solution.

 - Write a sentence explaining Cathy's pay rate. _____

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2. Cathy decides to spend some of her earnings from her new job, so she and her friend Brenda go to the mall. Their favorite store has blouses and jeans on sale. A variety of blouses is on one rack and are all the same price. A variety of jeans is on another rack and are all the same price. The price tags are not on the clothes but Cathy and Brenda know that the store's prices are usually within their budgets.

 Cathy picks out 3 blouses and 2 pairs of jeans from the sale racks. At the checkout, she sees that her total bill is $57.00. Brenda picks out 4 blouses and 3 pairs of jeans from the sale racks. Her total bill is $81.00. They are shopping in the state of Delaware where there is no sales tax.

 To find the cost of one blouse or one pair of jeans, Cathy and Brenda could just look at the sales receipt. Instead, they try to figure out the prices themselves.

 - Write the system of equations that Cathy and Brenda need to solve. Clearly define the variables and their meaning.

 - Solve the system of equations using elimination. Show your work and explain the steps you used to solve the system of equations. Show the check of your solution.

 Hint: You can multiply both equations by a factor to avoid working with fractions!

 - Write a sentence explaining the price Cathy and Brenda paid for each top and each pair of jeans.

 Remember: You always have a choice of picking the method that you think will be easiest to perform when solving systems of equations. In the problems above, you are asked to use a specific method.

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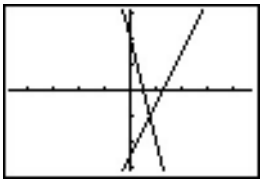
Try-It!™ on Your TI-83 Plus

You will:

- Graph two lines of a system of equations.
- Use [TRACE] to locate the intersection of the lines.
- Use the intersect feature to find the solution to a system of equations.
- Check the solution on the home screen using [STO▶].

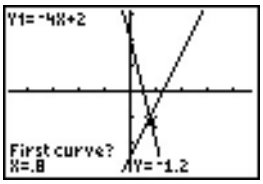
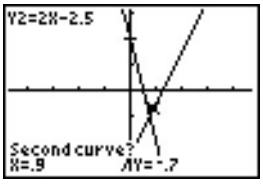
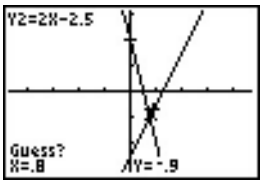
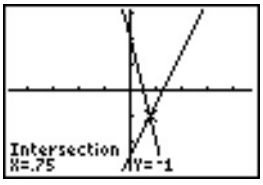
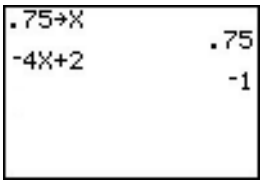
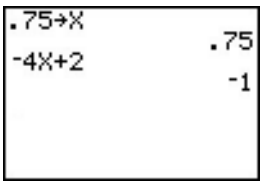
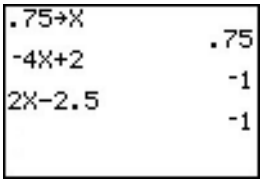
Find the solution of the system: $Y1 = -4X + 2$
$Y2 = 2X - 2.5$

Notice that these equations are already in the form of y = mx + b. They are in the form to enter into your calculator.

To Do This	Press	Display
1. Exit the Topics in Algebra 1 application and clear the Home screen.	[2nd] [QUIT] ⟨**EXIT**⟩ [CLEAR]	
2. First, enter **-4X + 2** as **Y1** and **2X – 2.5** as **Y2** in the Y= editor. **Note**: See TIp™ 3: Graphing a Function in the Standard Window for more information.	[Y=] [CLEAR] [(-)] **4** [X,T,Θ,n] [+] **2** [▼] [CLEAR] **2** [X,T,Θ,n] [−] **2** [.] **5**	
3. Select the Zoom Decimal viewing window. **Remember**: You have to adjust the viewing window depending on the system of equations. You can see the intersection of the lines in the ZDecimal window for this example.	[ZOOM] **4:ZDecimal**	
4. The graph displays. Since this system has one solution, you can find the numerical solution using the intersect feature. **Important Reminder:** Be sure to use your knowledge about the equations of lines to determine if the lines are parallel or the same line. When you use the intersect feature, an error displays if the lines are parallel. If the lines are the same line, the calculator shows ONLY one answer.		
5. Use the **CALCULATE** menu item called **intersect** to find the calculated numeric solution.	[2nd] [CALC] **5:intersect**	

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To Do This	Press	Display
6. You have to select a **First Curve** in order for the calculator to calculate the numerical solution. Notice the cursor is on the line Y1 = ⁻4X + 2.	ENTER	
7. You have to select a **Second Curve** in order for the calculator to calculate the solution. Notice the cursor is on the line Y2 = 2X − 2.5.	ENTER	
8. The calculator now needs a close guess at the solution. Move the cursor closer to the intersection.	▶ or ◀	
9. The calculator uses a program to calculate the numerical solution. The numerical solution given is at (0.75, ⁻1). Check to see if this solution is the exact solution or an approximate value.	ENTER	
10. Check the solution on the home screen. The value 0.75 is stored in the X variable in the calculator. X is fixed at 0.75 after you follow these steps. **Important Reminder:** The calculator always has a value stored in each variable. You must store the value you want in order to understand how the calculator interprets a variable expression.	2nd [QUIT] CLEAR . **75** STO▶ X,T,Θ,n ENTER	
11. Enter ⁻4X + 2 to find the Y1 value at X = 0.75. Notice that the output is ⁻1.	(-) **4** X,T,Θ,n + **2** ENTER	
12. Enter 2X − 2.5 to find the Y2 value at X = 0.75. Notice that the output is ⁻1 and Y1 = Y2 at X = 0.75. The solution is (0.75, ⁻1). Press GRAPH to see if this agrees with the graph of the lines!	**2** X,T,Θ,n − **2** . **5** ENTER	

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Extra Practice: Using Your Calculator to Find Solutions

1. Use your calculator to find the solution to each system of equations. Write the solution and a description of how you used your calculator to find and verify the solution.

 Remember: You need to rewrite the equations in the form y = mx + b to work with your calculator.

 Note: If the calculator gives the value .6666666667 or X=.66666666666666 in Solver the exact answer is most likely X = $\frac{2}{3}$.
 Explain how you found the exact answer if the calculator only gave an approximate answer. Verify your answer!

 a. $y = -1.2x + 3.725$

 $3x - y = 8.875$

 b. $3x + y = 6$

 $\frac{1}{2}x - \frac{1}{3}y = -1$

2. Solve each of the systems you found in **Extra Practice: Using Substitution or Elimination**, using your calculator. Write an explanation of how you used your calculator.

 a. Cathy's pay rate

 b. Cathy and Brenda's shopping trip

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Challenge

Investigate using the Solver feature on the TI-83 Plus to find the solution! Find this feature in MATH **0:Solver**. It is best to use this feature if the system has only one solution.

Hint: Press MATH and select **0:Solver**.You have to enter the equation in the Solver as 0 = ⁻ 4X + 2 – (2X–2.5) to solve for the X value. You have to input a guess for the X solution. **bound = {⁻1E99, 1E99}** represents the real number line for the calculator. You can make the set smaller to find solutions in a particular interval. Then, use ALPHA [SOLVE] to find the calculator's numerical solution. See the TI-83 Plus guidebook for more details about the Solver feature.

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Try-It!™ on Your TI-73

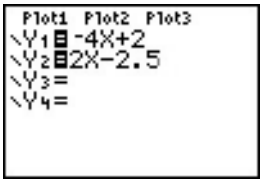
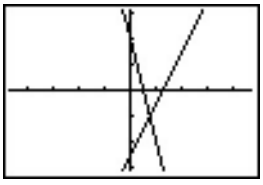
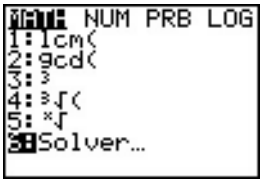
You will:

- Graph two lines of a system of equations.
- If the lines intersect, use the MATH feature Solver to find the X value of the solution to the system.
- Find the Y value by using STO▸ on the home screen.

Find the solution of the system: $Y1 = -4X + 2$

$Y2 = 2X - 2.5$

Notice that these equations are already in the form of y = mx + b. They are in the form to enter into your calculator.

To Do This	Press	Display
1. Exit the Topics in Algebra 1 application and clear the Home screen.	2nd [QUIT] ⟨**EXIT**⟩ CLEAR	
2. It is good practice to look at the graph of the system before you use the Solver feature. Enter **-4X + 2** as Y1 and **2X – 2.5** as Y2 in the Y= editor. **Note:** See TIp™ 3: Graphing a Function in the Standard Window for more information.	Y= CLEAR (-) **4** *x* + **2** ▼ CLEAR **2** *x* – **2** . **5**	
3. Select the Zoom Decimal viewing window. **Remember:** You will have to adjust the viewing window depending on the system of equations. You can see the intersection of the lines in the ZDecimal window for this example.	ZOOM **8:ZDecimal**	
4. The graph displays. Since this system has one solution, find the numerical solution next using the **Solver** feature on the TI-73. **Important Reminder:** Before you use the intersect feature, use your knowledge about the equations of lines to determine if the lines are parallel or the same line.		
5. Use the MATH menu item called **Solver** to find the calculated numerical solution.	MATH **6:Solver**	

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To Do This	Press	Display
6. To find the solution, you want to find when the two equations are equal. Find Y1 = Y2. You need to enter $^{-}4X + 2 = 2x - 2.5$ on the **eqn:** line.	(−) **4** x + **2**	EQUATION SOLVER eqn: -4X+2
7. Find the equal sign (=) in 2nd [TEXT].	2nd [TEXT] ▼ ▼ ▼ ENTER ▼	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z θ " _ = ≠ > ≥ < ≤ and or Done =
8. Finish entering the equation.	ENTER **2** x − **2** . **5**	EQUATION SOLVER eqn: -4X+2=2X-2.5
9. Enter a guess of X=1 as the solution. The calculator needs a starting value for its computation. **Hint:** bound = {-1E99, 1E99} represents the real number line for the calculator. You can make the set smaller to find solutions in a particular interval. See the TI-73 guidebook for more details.	ENTER CLEAR **1**	-4X+2=2X-2.5 X=1 bound={-1E99,1… Solve:X
10. Highlight **X** on the **Solve:X** line and the solution is given as ■X=.75. Notice that ■ appears after the calculator has computed the numerical solution.	▼ ▼ ENTER	-4X+2=2X-2.5 ■X=.75 bound={-1E99,1… Solve:X
11. Find the Y1 and Y2 values on the home screen using STO▶. The value 0.75 will be stored in the X variable in the calculator. X is fixed at 0.75 once you follow these steps. **Important Reminder:** The calculator always has some value stored in each variable. You must store the value you want in order to understand how the calculator interprets a variable expression.	2nd [QUIT] CLEAR . **75** STO▶ x ENTER	.75→X .75
12. Enter $^{-}4X + 2$ to find the Y1 value. Notice that the output is -1.	(−) **4** x + **2** ENTER	.75→X .75 -4X+2 -1

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Date _____

To Do This	Press	Display
13. Enter 2X − 2.5 to find the Y2 value. Notice that the output is ⁻1 and Y1 = Y2 at X = 0.75. The solution is (0.75, ⁻1). Press GRAPH to see if this agrees with the graph of the lines!	**2** [x] [−] **2** [.] **5** [ENTER]	.75→X .75 -4X+2 -1 2X-2.5 -1

Extra Practice: Using Your Calculator to Find Solutions

1. Use your calculator to find the solution to each system of equations. Write the solution and a description of how you used your calculator to find and verify the solution.

 Remember: You need to rewrite the equations in the form y = mx + b to work with your calculator.

 Note: If the calculator gives the value .6666666667 or X=.66666666666666 in Solver, the exact answer is most likely X = $\frac{2}{3}$.
 Explain how you found the exact answer if the calculator only gave an approximate answer. Verify your answer!

a. $y = -1.2x + 3.725$

 $3x - y = 8.875$

b. $3x + y = 6$

 $\frac{1}{2}x - \frac{1}{3}y = -1$

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Date _____

2. Solve each of the systems you found in **Extra Practice: Using Substitution or Elimination** using your calculator. Write an explanation of how you used your calculator.

 a. Cathy's pay rate

 b. Cathy and Brenda's shopping trip

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Linear Systems: Using Algebra Teacher Notes

Objectives

- To review the substitution method of solving a system of two linear equations in two variables.
- To review the elimination method of solving a system of two linear equations in two variables.
- To review the definitions of consistent (independent and dependent) and inconsistent systems.
- To associate the number of solutions of a system with the classification of consistent (independent and dependent) and inconsistent systems.

Math Highlights

In this section, students work with a linear system of equations with two equations and two variables and review the methods of substitution and elimination.

In the **Overview**, students associate the graphs of the lines of a system with the number of solutions of the system and the classification of the system as consistent and inconsistent (dependent and independent) systems. This was also covered at a lower level in Section 1: Using Graphs & Tables.

In the substitution example, caramel corn is sold as a class fundraiser, and the students need to know how many bags of caramel corn they need to sell to make a profit. A system of linear equations is written to model the costs of producing the caramel corn and the revenue earned from selling bags of caramel corn. Solving the system of equations gives the number of bags of caramel corn the students need to sell to make a profit. The term *profit* is used and should be discussed in the class. The terms *breakeven* and *loss* are not covered, but students would benefit from a complete classroom discussion of the problem, not just the profit point.

In the elimination example, Jon and Mia earn money by recycling cans and glass. The recycling center gives each of them one payment for both the cans and the glass. Jon and Mia want to know how much money they earned for each pound of cans and each pound of glass. A system of linear equations is written to model the amount of money that Jon and Mia earned for recycling. Solving the system of equations gives the prices per pound that they were paid for cans and glass. Students can eliminate either variable in the example.

The variables used in these problems are x and y; however, you should encourage students to use variables that make sense in the problem.

The Try-It!™ examples for the TI-83 Plus and the TI-73 are slightly different. They are printed on separate pages so that you can make copies of only the pages you need. Students can use either calculator to complete the problems in the Student Worksheet.

Common Student Errors

- When they use the substitution method, students may make sign and division errors when they solve for one of the variables. They may also need to be reminded to use parentheses when needed. Students might incorrectly distribute expressions.
- When solving by substitution, students might solve one equation for y (or x) and substitute back into the same equation getting a result of $0 = 0$, when they should have substituted back into the other equation.
- When they use the elimination method, students may miss multiplying every term in an equation by the appropriate constant.
- As they continue using the elimination method, many students subtract incorrectly. They usually subtract the first term correctly, but often forget to subtract the other terms. Encourage students to choose the multiplier so that they add the equations for the elimination rather than subtract them.
- When an algebraic solution results in a statement that is always true, such as $2 = 2$ in a dependent system (coincident lines), or a statement that is never true, such as $2 = 4$ in an inconsistent system (parallel lines), students may be unsure how to state the solution.
- Students often skip checking their solution. In addition to checking their solution by substituting it back into the original equations, they should also make sure that the solution is reasonable. For example, in the Student Worksheet problem where Cathy and Brenda are shopping for tops and jeans, the variable must be positive.
- Students should practice rewriting the system after each step to keep track of their manipulations.

Encourage students to create good math habits by doing the following.

- Pick the method—graphs, tables, substitution, or elimination—which is best for the system. First, look at the physical problem, if appropriate, or use geometry and number sense to analyze the system.
- Remember that for real problems (word problems), some solutions may need to be omitted. For example, if you need to find the quantity of an item, the solution must be positive.
- Notice when a system obviously has no solution because the lines have the same slope (i.e., parallel lines), and when a system has an infinite number of solutions because the lines are the same line.
- Rewrite the system after each step to keep track of the manipulations.

 Note: Students who can think through the steps in their mind tend to be impatient with recording each step. However, forming this habit now will help them in the future, especially when they learn how to solve systems using matrices.
- Write out the mathematics you use to solve the system. Also, write phrases or sentences that explain your steps. Draw graphs and tables to use as aids.
- Interpret what the solution means in real problems. For example, the recycling problem in the **Overview** subsection requires not only the numeric answer but also an explanation about what the numbers mean with respect to the price per pound.

 Tip: Have students look in newspapers and on the web for graphs and tables of information to show real examples of the importance of both computations and explaining what the computations mean.

Student Worksheet Notes with Answers

Overview

Tell students:

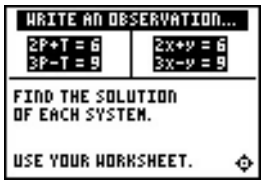
1. How to find the **Overview**, if necessary.

2. How to navigate the application, if necessary.

3. To scroll through the **Overview** on the calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

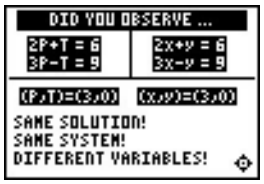
Observations

The **Observations** help students review substitution and elimination methods. If necessary, tell students how to find the **Observations**.

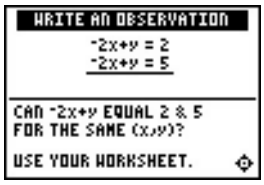


Observation 1

Students are asked to solve both systems using either the substitution method or the elimination method. The systems are identical except for the choice of variables. Students should become comfortable with a change in variables and should recognize that they do not have to do this calculation twice.



Observations (continued)

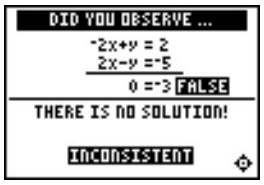


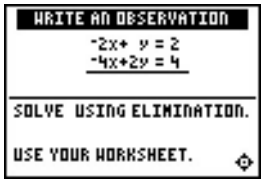
Observation 2

Students are asked if the same left-hand sides of the equations can equal different right-hand sides. They should be able to reason this out using their number sense. They can then verify their answer using algebra. They will see the verification using the elimination method on the following screens in the application.

The second equation is multiplied by -1 and then the equations are added. Multiplying by -1 was chosen to avoid sign errors.

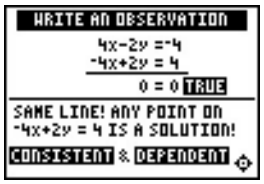
Some students will want to immediately subtract the two equations. This is also correct, but they need to be very careful to subtract each term!





Observation 3

Students see the elimination steps on the following screens in the application. The result screen is given below.



Activities



Scoring: Students get one attempt to pick the correct classification of the system. They earn 2 points for each correct choice, and 1 point for a correct choice if they press ⟨HINT⟩ to see the graph.

Four systems are given for a maximum score of 8 points.

What Am I?

Tell students to:

1. Highlight a level (silver = less difficult; form y = mx + b; gold = more difficult; mixed slope-intercept and standard forms), and press ENTER to select it.

2. Look at the system of equations and decide if the system is consistent & independent, consistent & dependent, or inconsistent.

3. Write out the algebraic steps to make this determination, except possibly at the silver level. Students could use their knowledge of the graph of y = mx + b in order to answer some problems.

4. Press ⟨**HINT**⟩ if they want to see a graph of the system. They will only get 1 point for the problem if they use the ⟨**HINT**⟩.

5. Press ▲ or ▼ to cycle through the choices and then press ENTER to select the correct answer. The correct answer and graph will show if the incorrect answer is chosen. They must press a key to continue play. As they play the activity, students should write an algebraic solution to the system on their worksheet.

6. Record the level they played.

7. Record their scores.

Activities (continued)



Scoring: Students get two attempts to pick or input the correct solution to the system of equations. They earn 2 points for a correct choice or input on the first try, and 1 point for a correct choice or input on the second try.

There are 4 problems for a maximum score of 8 points.

Balloon Ride

Tell students to:

1. Read the introduction screen and then highlight a level (silver = less difficult; gold = more difficult), and press ENTER to select it. Students answer multiple-choice problems in the silver level and they input their solution in the gold level.

 Silver Level: Press ▲ or ▼ to cycle through the solutions to choose from, and then press ENTER to select the solution. Students must press a key to continue play.

 Gold Level: Use ▲ or ▼ to select an answer or to get to the input box. Select or input your answer and press ENTER. (Press (−) to enter negative numbers.) Students must press a key to continue play.

3. As they play the activity, students should write their work using either elimination or substitution.

4. Record the level they played.

5. Record their scores.

Extra Practice: Using Substitution or Elimination

1. Cathy's pay rate can be determined by the following.

 Let S = hourly pay rate
 Let T = overtime pay rate

 Week 1: $10S + 4.5T = 93.75$
 Week 2: $10S + 2T = 75 \rightarrow 10S = 75 - 2T$

 To use substitution, the student could solve the Week 2 equation for 10S, $10S = 75 - 2T$. Then, the Week 1 equation becomes the following.

 $(75 - 2T) + 4.5T = 93.75 \rightarrow 2.5T = 18.75 \rightarrow T = 7.5$

 Once T is known, substitute T into either equation and solve for S.

 $10S + 4.5(7.5) = 93.75 \rightarrow 10S = 60 \rightarrow S = 6$

 Interpret the answer:

 S = \$6.00 per hour
 T = \$7.50 per hour

 Cathy earns \$6.00 per hour for the first 10 hours and \$7.50 per hour for any overtime.

2. Brenda and Cathy can figure out the cost of each top and pair of jeans purchased by the following.

 Let T = price of one top
 Let J = price of one pair of jeans

 Cathy: $3T + 2J = 57$

 Brenda: $4T + 3J = 81$

 To use elimination, multiply Cathy's equation by 4 and Brenda's equation by -3.

 Cathy: $12T + 8J = 228$

 Brenda: $-12T - 9J = -243$

 Add the two equations to get:

 $-J = -15 \rightarrow J = 15$

 Substitute this value for J into either equation to find T.

 $3T + 2(15) = 57 \rightarrow 3T = 27 \rightarrow T = 9$

 Interpret the answer:

 T = $9.00 per top
 J = $15.00 per pair of jeans

 Cathy and Brenda paid $9.00 for each top and $15.00 for each pair of jeans.

Try-It!™ on Your TI-83 Plus and TI-73

Note: The **Try-It!** exercises cover different functionality available to solve a system of equations. The TI-83 Plus exercise uses the intersect feature that the TI-73 does not have. The TI-73 exercise uses the Solver to solve an independent system. The TI-83 Plus also has a Solver feature. Using the Solver feature on the TI-83 Plus is given as a challenge investigation for the students. (Hints are given below.) The linear system to be solved is the same for both calculators. The problem set, **Using Your Calculator to Find Solutions**, given after the **Try-It!,** is identical and is repeated after each **Try-It!** for your copying convenience.

On the TI-83 Plus, students will:

- Graph two lines of a system of equations.
- Use [TRACE] to locate the intersection of the lines.
- Use the [2nd] [CALC] **intersect** feature to find the solution to a system of equations.

Check the solution on the home screen using [STO▶].

On the TI-73, students will:

- Graph two lines of a system of equations.
- If the lines intersect, use the [MATH] **Solver** feature to find the X value of the solution to the system.
- Find the Y value by using the [STO▶] on the home screen.

Reminders for the Try-It!™ Exercises

TI-83 Plus and TI-73:

- Only the variables X and Y are used for graphs and tables. If an equation uses letters other than X and Y, you have to change the variables in the problem to X and Y in order to use some features on the calculators.
- Some value is always stored in each variable. You must store the value you want in order to understand how the calculator interprets a variable expression. The calculator does not perform symbolic manipulations.
- The intersect feature on the TI-83 Plus and the Solver feature on both the TI-83 Plus and the TI-73 are best used to find the solution to a system with one solution. Students should use their knowledge about the equations of lines to determine if lines are parallel or the same line before working the problem.
- In the Solver, **bound = {-1E99, 1E99}** represents the real number line for the calculator. You can make the set smaller to find solutions in a particular interval. See the TI-83 Plus or TI-73 guidebook for more details.

TI-83 Plus:

- When the intersect feature is used, an error is displayed if the lines are parallel. If the lines are the same line, the calculator will show *only* one answer.
- In the challenge problem, students are asked to investigate using the Solver feature on the TI-83 Plus to find the solution. Find this feature in [MATH] **0:Solver**. See the TI-83 Plus guidebook for details about the Solver feature. You have to enter the equation in the Solver as $0 = -4x + 2 - (2x - 2.5)$. You have to input a guess for the X solution. Then, use [ALPHA] [SOLVE] to find the calculator's numerical solution.

Extra Practice: Using Your Calculator to Find Solutions

Note: These problems are identical for both the TI-83 Plus and the TI-73.

1a. (3, 0.125)

1b. (2/3, 4)

2a. Answers will vary. Students use their choice of calculator feature to solve for Cathy's pay rate.

2b. Answers will vary. Students use their choice of calculator feature to solve for Cathy and Brenda's shopping trip.

TIp™ 1: Resetting Your Calculator

You can easily reset all default, or factory, settings on your calculator from the **MEMORY** menu. Resetting the default settings ensures that all calculators show exactly the same results in the same form.

Resetting defaults does not erase any lists, programs, or variables stored in memory.

Note: You should reset your calculator's default settings to ensure that the results you see on your calculator will match the results in all example screens in the TIps.

Resetting your calculator to the defaults	For more information
Resets all mode and window format defaults.	TIp 2: *Adjusting Your Calculator Settings*
Turns off function plots.	TIp 3: *Graphing a Function in the Standard Window*
Resets window values to **ZStandard**.	TIp 5: *Adjusting the Viewing Window*
Turns off statistical plots.	TIp 7: *Creating a Statistical Plot*

Calculator Keys Used in This TIp™

2nd [MEM] **7:Reset 2:Defaults 2:Reset**

TIp™ Highlights

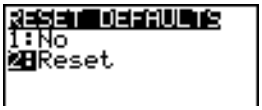
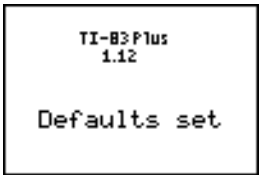
Your calculator contains many settings that control the interpretation of results and graphs. For example, you can control how the calculator:

- Displays mathematical results (for example, with floating or fixed decimal notation).
- Interprets and displays graphs and statistical plots (for example, scale of the **X**-axis and **Y**-axis).

Note: Types of settings vary between the TI-83 Plus and the TI-73. For more information, see the calculator guidebook.

Try-It!™ on Your TI-83 Plus or TI-73

Reset the calculator defaults.

To Do This	Press	Display (TI-83 Plus shown)
1. Display the **MEMORY** menu and select **Reset**.	2nd [MEM] **7:Reset**	
2. Select **Defaults**.	**2:Defaults**	
3. Select **Reset** to reset the calculator.	**2:Reset**	
4. Clear the screen and return to the Home screen.	CLEAR	 TI-83 Plus  TI-73

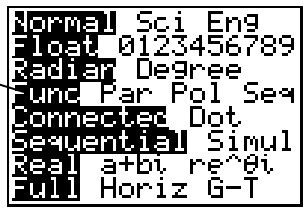
You are now ready to work through the TIps. Remember, resetting the calculator ensures that you get the same results shown in all TIps examples.

After you become familiar with your calculator, it will not be necessary to reset it every time because you will know how you have changed the settings, and you will understand the results the calculator displays in light of those changes.

TIp™ 2: Adjusting Your Calculator Settings

You can control how the calculator displays results and graphs by changing settings. For example, the mode settings screen is displayed below (varies slightly for the TI-73). The highlighted settings are the ones that are selected.

All highlighted settings are selected.



Calculator Keys Used in This TIp™

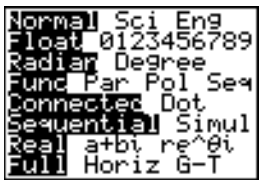
- MODE
- 2nd [FORMAT]

TIp™ Highlights

This TIp shows how to change settings on two frequently-used screens—the mode screen and the window format screen. For more information about settings, see the calculator guidebook.

- Mode (MODE) settings determine how the calculator interprets and/or displays numbers and results.
- Window format (2nd [FORMAT]) settings determine how the calculator interprets and/or displays graphs.

Note: The TI-83 Plus and the TI-73 mode and window format screens are slightly different.

TI-83 Plus		TI-73	
			
Mode screen	Window Format Screen	Mode screen	Window Format Screen

In the TIp Try-It! example, you will select new calculator settings following these main steps.

1. Display the setting screen.
2. Press ▼, ▲, ◀, or ▶, as necessary, to highlight the setting you want to select.
3. Press ENTER to select it.

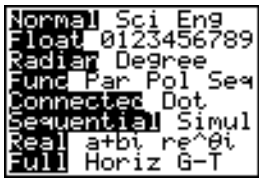
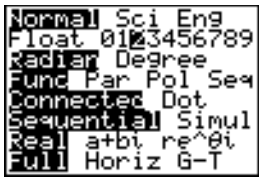
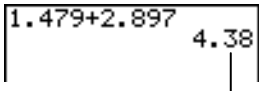
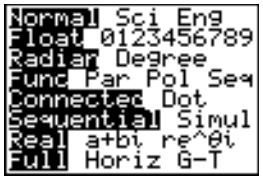
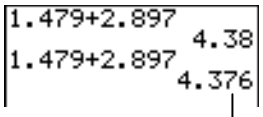
Note: The examples in the next section assume that the calculator has been reset to the default settings as described in TIp 1: *Resetting Your Calculator.*

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Try-It!™ on Your TI-83 Plus or TI-73

Change a Mode Setting

Change the mode setting so that results display to 2 decimal places.

To Do This	Press	Display (TI-83 Plus shown)
1. Display the mode settings screen. **Note**: The TI-73 mode screen varies slightly from the TI-83 Plus.	MODE	
2. Change the decimal notation setting from **Float** to **2**.	▼ until **Float** is highlighted ▶ until **2** is highlighted ENTER to select	
3. Press 2nd [QUIT] to return to the Home screen, and clear the current line, if needed. **Tip:** Pressing 2nd [QUIT] always takes you back to the Home screen, except in the Topics in Algebra 1 application.	2nd [QUIT] CLEAR	
4. Calculate 1.479 + 2.897.	**1 . 4 7 9 +** **2 . 8 9 7** ENTER	 The calculator rounds the result to 2 decimal places.
5. Change the decimal notation setting back to **Float**. **Note: Float** displays a number up to 10 digits.	MODE ▼ until **Float** is highlighted ENTER to select	
6. Return to the Home screen.	2nd [QUIT]	
7. Calculate 1.479 + 2.897 again. **Tip**: On the TI-73, you can press ▲ ▲ to highlight a previous entry on the Home screen, and then press ENTER to paste it to the current line.	2nd [ENTRY] to display the previous entry ENTER	 The calculator displays up to 10 digits.

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Change a Window Format Setting

To display a grid on the graph screen, select **GridOn** from the window format screen.

To Do This	Press	Display (TI-83 Plus shown)
1. Display the window format screen. **Note**: The TI-73 mode screen varies slightly from the TI-83 Plus.	2nd [FORMAT]	
2. Change the grid setting from **GridOff** to **GridOn**.	▼ until **GridOff** is highlighted ▶ until **GridOn** is highlighted ENTER to select	
3. Show the graph screen. Notice both the grid and axes are on.	GRAPH	

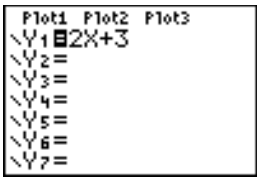
On Your Own

- Change your mode setting (MODE) to scientific notation (**Sci**). Do some calculations on the Home screen. Try **25*63**. Notice how the calculator displays scientific notation. Is this the way you write scientific notation? Explain how this setting affects your results.

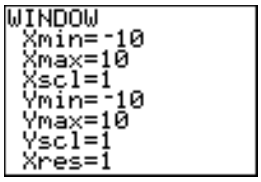
- Turn the grid off on the graph screen. Check this by pressing GRAPH.

TIp™ 3: Graphing a Function in the Standard Window

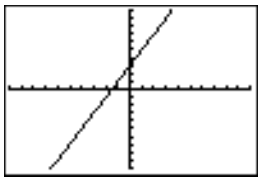
You can graph a function on the graph screen. First, enter the function in the Y= editor, and then you can graph the function in the standard graphing window. Screens on the TI-73 may vary.



Y1=2x+3 in the Y= editor



Standard Graphing Window



Graph of **Y1=2x+3**

Calculator Keys Used in This TIp™

- Y=
- GRAPH
- TRACE

TIp™ Highlights

In the TIp Try-It! example, you will graph a function following these main steps.

1. Enter the function in the Y= editor (Y=).
2. Graph the function on the graph screen (GRAPH).

 Note: If you reset your calculator defaults (TIp 1: *Resetting Your Calculator*), the graphing window sets up the following boundaries for the **X** and **Y** values: $-10 \le \mathbf{X} \le 10$ and $-10 \le \mathbf{Y} \le 10$.

3. Press TRACE. Then press ▶ or ◀ to move the cursor from one plotted point to another. Tracing the graph displays the (**X,Y**) values at the bottom of the screen.

For some functions, the graphing window has to be adjusted so that you can see your graph. This TIp uses the standard window settings ($-10 \le \mathbf{X} \le 10$ and $-10 \le \mathbf{Y} \le 10$). The function selected for the example on the next page displays the graph in this window. For more information on adjusting window settings on the **WINDOW** menu, see TIp 5: *Adjusting the Viewing Window*.

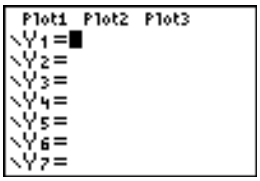
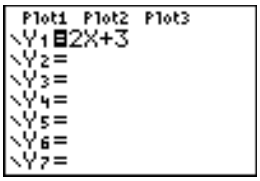
Note: The examples in the next section assume that the calculator has been reset to the default settings as described in TIp 1: *Resetting Your Calculator.*

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Try-It!™ on Your TI-83 Plus or TI-73

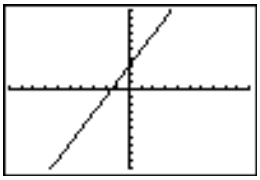
Enter the Function

Enter $y = 2x + 3$ as **Y1=2X+3** in the Y= editor.

To Do This	Press	Display (TI-83 Plus shown)
1. Enter the Y= editor. **Note:** The TI-73 Y= editor varies slightly from the TI-83 Plus. The TI-73 lets you enter up to 4 functions.	[Y=]	
2. Clear **Y1** and enter the function, **2X+3**. **Note**: On the TI-73, use [x] rather than [X,T,Θ,n]. **Note:** The equal sign next to the function is highlighted. This means that the function is selected or turned on and will be graphed. If other functions are selected, press [▼] and [◄] as necessary to position the cursor over the **=** sign and press enter to turn off the function.	[CLEAR] **2** [X,T,Θ,n] [+] **3**	

Display the Graph

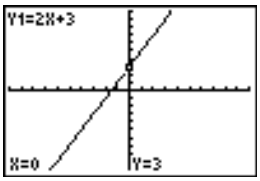
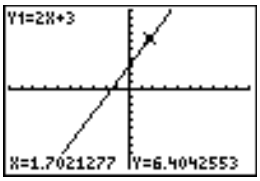
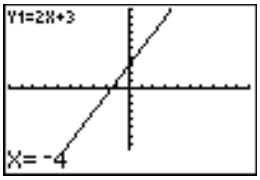
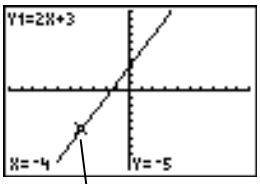
Display the graph of **Y1=2X+3** on the graph screen.

To Do This	Press	Display (TI-83 Plus shown)
1. Display the graph.	[GRAPH]	

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Trace the Graph

Trace the (**X**,**Y**) values for **Y1=2X+3** on the graph screen.

To Do This	Press	Display (TI-83 Plus shown)
1. Enter trace mode.	[TRACE]	
2. Trace the (**X**,**Y**) values along the graph. **X** and **Y** values display at the bottom of the screen.	[▶] and [◀]	
3. Quickly find **Y** when **X=-4**.	[(-)] **4**	
4. Notice that when **X=-4** then **Y=-5**.	[ENTER]	 Cursor moves to (-4, -5).

On Your Own

- Display a grid on the graph screen by selecting **GridOn** in the window format screen ([2nd] [FORMAT]).
- Define **Y2= -X+6**.
- Graph **Y1=2X+3** and **Y2= -X+6** at the same time and compare. Now trace along each function to find the point of intersection. Record the point of intersection.

 Hint: Use [▼] and [▲] to move between functions.
- Graph **Y2** only.

 Hint: You must deselect **Y1** so that the calculator does not graph it. To deselect **Y1**, highlight its equal sign (**=**) in the Y= editor with the cursor, and then press [ENTER]. Notice the equal sign is no longer highlighted.

TIp™ 4: Creating a Table

You can automatically create a table of values (**X**,**Y**) based on functions in the Y= editor. For example, if **Y=2X+3** is defined in the Y= editor, a corresponding table of (**X**,**Y**) values could look like this:



Y1=2x+3 in the Y= editor

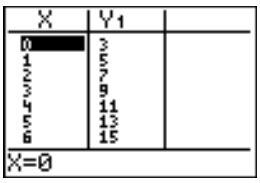


Table for **Y1=2x+3**

Calculator Keys Used in This TIp™

- 2nd [TABLE]
- 2nd [TBLSET]

TIp™ Highlights

In the Try-It! example, you will display the table values (**X**,**Y**) for a function defined in the Y= editor following these main steps.

1. Define a function (**Y1=2X+3**) in the Y= editor (Y=).
2. Set up your table in the **TABLE SETUP** screen (2nd [TBLSET]).
3. Display the table (2nd [TABLE]).

The following settings in the table setup (2nd [TBLSET]) screen determine how the table is displayed.

- **TblStart** — First **X** value.
- Δ**Tbl** — Amount by which **X** values increase and decrease (for example, if Δ**Tbl=5**, then **X** values increase or decrease by 5).
- **Auto** or **Ask** — Allows you to choose whether or not to display automatically the independent (X) or dependent (Y) variable values.

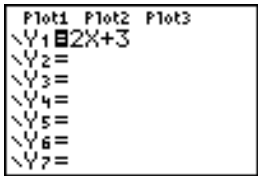
For more information about table settings, see the calculator guidebook.

Note: The examples in the next section assume that the calculator has been reset to the default settings as described in TIp 1: *Resetting Your Calculator.*

Try-It!™ on Your TI-83 Plus or TI-73

Enter the Function

Enter **Y1=2X+3** in the Y= editor (Y=). See TIp 3: *Graphing a Function in the Standard Window* for step-by-step instructions for defining functions. Your Y= editor should look like this.



Change the Table Settings

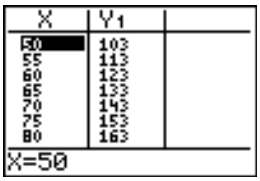
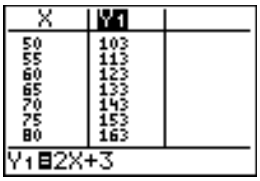
Define the following settings for your table: **TblStart=50** and **ΔTbl=5**.

To Do This	Press	Display (TI-83 Plus shown)
1. Display the table setup screen.	2nd [TBLSET]	
2. Change the following settings: **TblStart=50**, **ΔTbl=5**. **Note: Indpnt:Auto** and **Depend:Auto** are the defaults.	CLEAR **50** ▼ CLEAR **5**	

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Display the Table

Display the table for **Y1=2X+3** on the graph screen.

To Do This	Press	Display (TI-83 Plus shown)
1. Display the table.	2nd [TABLE]	
2. Scroll through the table values with the arrow keys. **Note:** Notice that when you press ▲ and move to the top of the **Y1** column, the cursor moves to **Y1** instead of displaying **Y**-values that are off the screen. The function is displayed on the edit line and can be changed.	◄, ►, ▼, or ▲ as necessary	

On Your Own

- Try to display more (**X,Y**) values. Set Δ**Tbl=1** (pronounced "delta table") and display the table again. Then set Δ**Tbl=.1** and display the table. Notice how the table values differ.

- Enter **Y2=-X+6** in the Y= editor. Display the table of values for both **Y1** and **Y2**. Is **Y1** ever equal to **Y2**?

 Hint: Set **TblStart=0** and Δ**Tbl =1** and search through the table.

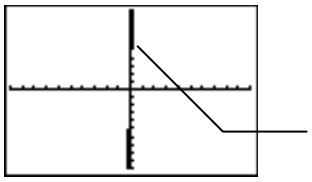
- Change the mode ([MODE]) setting from **Normal** to **Sci**. Display the table. Notice how this affects the table values.

- Go to the table setup screen and figure out what the **Depend: Ask** setting does.

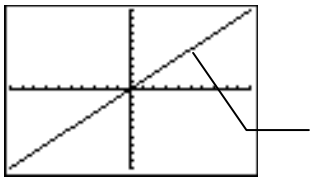
 Hint: To reveal an invisible **Y** value in the table, place the cursor on that space and press [ENTER].

TIp™ 5: Adjusting the Viewing Window

You can adjust the viewing window for a specific graph. For example, with the **ZStandard** viewing window default values of $-10 \le X \le 10$ and $-10 \le Y \le 10$, the graph of **Y1=50X** appears as shown in the screen below on the left. **Y** increases so rapidly in relation to **X** that this line is not easily seen in this window. You can adjust the window (WINDOW) values by scaling the **X** axis and **Y** axis to see the graph in a better perspective.



Y1=50X viewed with the default window values.



Y1=50X viewed with adjusted window values.

Calculator Keys Used in This TIp™

- WINDOW
- ZOOM

TIp™ Highlights

Window values put specific boundaries on the graph screen. **ZOOM** (ZOOM) functions automatically adjust window values for you; however, you can manually set window values using the window (WINDOW) menu. You can set minimum and maximum **X** and **Y** values (**Xmin**, **Xmax,** **Ymin**, and **Ymax**), and you can set the scale (distance between tick marks) of the **X** axis and **Y** axis (**Xscl** and **Yscl**).

In the TIp Try-It! example, you will adjust the viewing window values in two ways.

- Automatically adjust them by selecting a zoom function from the **ZOOM** (ZOOM) menu.
- Manually adjust them using the window (WINDOW) menu.

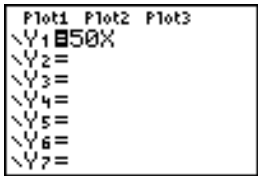
In the example that follows, you see how to change window (WINDOW) values to see a different perspective of the graph of **Y1=50X**.

Note: The examples in the next section assume that the calculator has been reset to the default settings as described in TIp 1: *Resetting Your Calculator*.

Try-It!™ on Your TI-83 Plus or TI-73

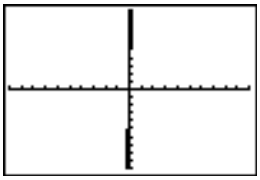
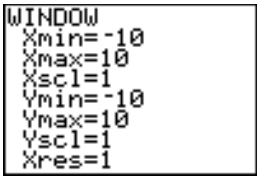
Enter the Function

Enter **Y1=50X** in the Y= editor ([Y=]). See TIp 3: *Graphing a Function in the Standard Window* for step-by-step instructions for defining functions. Your Y= editor should look like this.



Display the Function on the Graph Screen

Note: The window values shown here are the default window values, also equivalent to **ZStandard** ([ZOOM]) (-10 ≤ **X** ≤ 10; -10 ≤ **Y** ≤ 10).

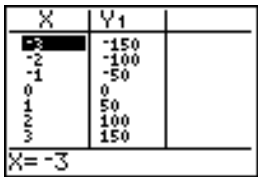
To Do This	Press	Display (TI-83 Plus shown)
1. Graph **Y1**.	[GRAPH]	
2. Display the window settings menu. **Note:** This window shows (**X**,**Y**) values so that -10 ≤ **X** ≤ 10 and -10 ≤ **Y** ≤ 10. This is equivalent to the default **ZStandard** setting.	[WINDOW]	

Define a Different Viewing Window for Your Graph

View the table of (**X**,**Y**) values created by **Y1**=**50X** to help you redefine window values. Start the table at -3 and increment the values by 1. See TIp 4: *Creating a Table* for step-by-step instructions for creating a table.

Tip: You can choose any **X** values for the table. For this exercise, you view a table of values when -3 ≤ **X** ≤ 3. When you set the table to start at -3 with increments of 1, you can see the relationship between **X** and **Y** near the origin of the graph.

Your table should look like this:

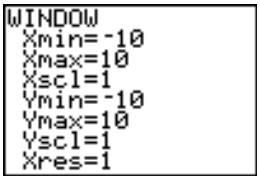
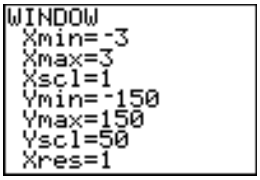
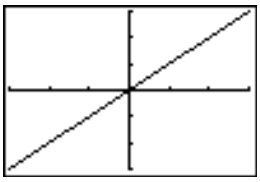
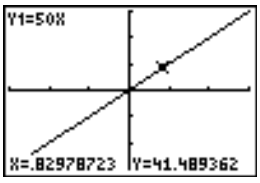
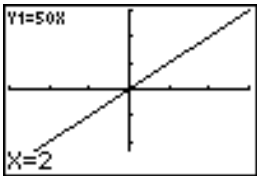
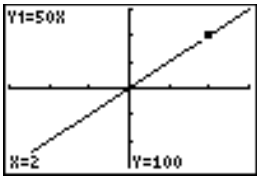


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Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Define a Different Viewing Window for Your Graph (continued)

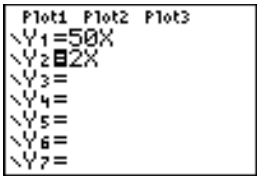
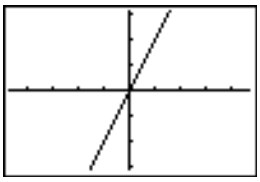
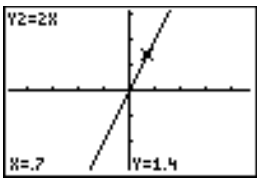
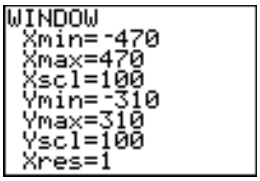
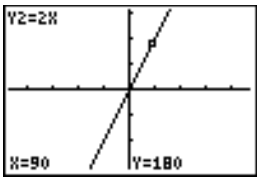
Notice in the table that when $-3 \le \mathbf{X} \le 3$, the **Y** values range from $-150 \le \mathbf{Y} \le 150$. Since **Y** increases by 50 each time **X** increases by 1, you can set the **Yscl** to 50 and leave **Xscl** set at 1. Now, create a window to see the graph for this domain and range by changing the window values.

To Do This	Press	Display (TI-83 Plus shown)
1. Display the window settings screen. **Note:** Window settings screen is slightly different on the TI-73.	WINDOW	
2. Define the values so that **Xmin = -3, Xmax = 3, Xscl = 1,Ymin = -150**, **Ymax = 150**, and **Yscl = 50**. **Note:** This changes the settings so that: $-3 \le \mathbf{X} \le 3$ and $-150 \le \mathbf{Y} \le 150$. Since **Xscl=1** and **Yscl=50**, there is one unit between each tick mark on the **X** axis and 50 units between each tick mark on the **Y** axis. TI-73: Δ**X** scales automatically, based on **Xmin** and **Xmax**. See the calculator guidebook for details.	(-) **3** ▼ (to **Xmax**) **3** ▼ (to **Ymin**) (-) **150** ▼ (to **Ymax**) **150** ▼ (to **Yscl**) **50**	
3. Graph **Y1=50X** in this different window. **Note:** Remember that each tick mark on the **X** axis represents 1 unit, while each one on the **Y** axis represents 50. It's always important to know the scale of your graphs so that you understand the graph you are viewing.	GRAPH	
4. Trace the graph. **Note:** Each tick mark on the **X** axis is 1 and on the **Y** axis is 50.	TRACE ◄ or ► as necessary	
5. Display the **Y** value when **X=2**. **Tip:** You can go directly to any coordinate pair on the graph by entering the value you want.	**2** ENTER	 

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Using ZDecimal—the Friendly Window

- Display and trace the graph **Y2=2x**, using **ZDecimal** window values. **ZDecimal** lets you trace the **X** values by tenths (.1, .2, .3, …).
- Multiply **Xmin**, **Xmax**, **Xscl**, **Ymin**, **Ymax,** and **Yscl** by 100 in the window menu, and trace the function. This lets you trace the **X** values by tens.

To Do This	Press	Display (TI-83 Plus shown)
1. Turn off the graph and table of **Y1=50X** and enter **Y2=2x** in the Y= editor. **Note**: On the TI-73, use [x] rather than [X,T,Θ,n].	[Y=] [◄] [ENTER] [▼] [►] [CLEAR] **2** [X,T,Θ,n]	
2. Graph **Y2=2x** using **ZDecimal** window values.	[ZOOM] [▼] until **ZDecimal** is highlighted [ENTER]	
3. Trace the graph. **Note:** Notice that the window is set up so that the **X** values are tracing by tenths.	[TRACE] [◄] or [►] as necessary	
4. Multiply **Xmin, Xmax**, **Xscl**, **Ymin**, **Ymax**, and **Yscl** by 100. **Tip:** Press [2nd] [►] to move the cursor to the end of a window setting line. **Note:** TI-83 Plus: See the calculator guidebook for details about **Xres**. It is not discussed in this TIp. TI-73: See the calculator guidebook for details about ΔX. It is not discussed in this TIp.	[WINDOW] Repeat for each value: [2nd] [►] [×] **100** [ENTER]	
5. Trace the graph. **Note:** Notice that the window is set up so that the **X** values are tracing by tens.	[TRACE] [◄] or [►] as necessary	

On Your Own

Graph **Y1=.1X**. How can you set an appropriate viewing window for this graph?

Hint: Make a table of values for **Y1=.1X** and use the table information to change the window values. Try finding the best values to choose when $-5 \le X \le 5$. If **X=5**, **Y=.1(5)=.5**. Therefore, the **Y** values need to be very small. Try changing **Ymin**, **Ymax**, and **Yscl**.

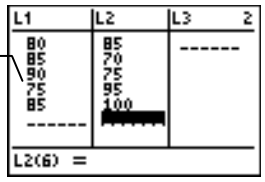
TIp™ 6: Using Lists

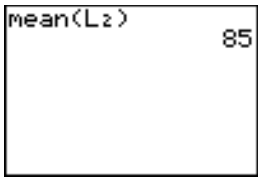
You can enter lists of different kinds of data into the list editor. For example, let's look at two students' test scores.

- Jamal's test scores are 80, 85, 90, 75, and 85.
- Jian's test scores are 85, 70, 75, 95, and 100.

You can create two separate lists in the list editor containing these scores. Then, on the Home screen, you can find the sum of the elements of both lists, and then divide by the number of elements (5) to calculate each student's test average or mean.

L1 lists Jamal's scores.





You can find the mean or median on the Home screen.

Calculator Keys Used in This TIp™

- 2nd [CATALOG] (to access the **ClearAllLists** and **SetUpEditor** commands)
- TI-83 Plus: 2nd [LIST], STAT
- TI-73: LIST, 2nd [STAT]

TIp™ Highlights

Both the TI-83 Plus and the TI-73 have two menus—**OPS** and **MATH**—that contain various list commands that help you find mean, median, and much more. For more information on all menu items, see the calculator guidebook.

TI-83 Plus:
2nd [LIST] ▶ ▶



TI-73:
2nd [STAT] ▶ ▶



In the Try-It! example, you will use the **ClearAllLists** and **SetUpEditor** commands, which are located in the **CATALOG** (2nd [CATALOG]) on both the TI-83 Plus and the TI-73. These commands clear and set up the list editor as described below.

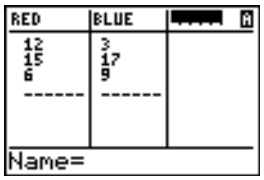
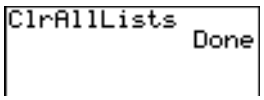
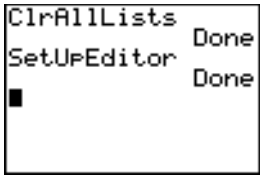
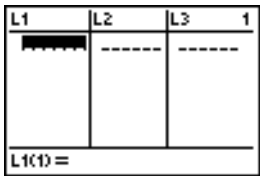
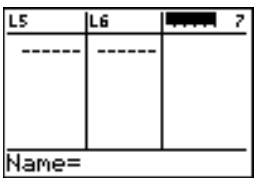
- **ClearAllLists** erases all elements of all existing lists on your calculator. The list names are still in memory, but the lists are empty. You cannot get the list elements back.
- **SetUpEditor** removes all list names from the list editor except the default list names, **L1** through **L6**. It also creates one blank list after **L6**.

Note: The examples in the next section assume that the calculator has been reset to the default settings as described in TIp 1: *Resetting Your Calculator*.

Try-It!™ on Your TI-83 Plus or TI-73

Set Up the List Editor

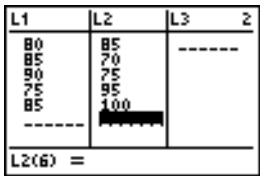
Use the commands **ClearAllLists** and **SetUpEditor** to reset the list editor.

To Do This	Press	Display (TI-83 Plus shown)
1. Display the list editor. **Note:** Your list editor may vary. The following commands will clear and set up lists **L1** through **L6** in your list editor.	TI-83 Plus: [STAT] **1:Edit** TI-73: [LIST]	
2. Return to the Home screen and clear it. Then clear all lists in the list editor by selecting **ClearAllLists**. **Note:** This command clears all elements from the lists. The list names are still in memory, but the lists are empty. **Hint**: In the **CATALOG**, you can go to the first item starting with a particular letter: TI-83 Plus: Press **C** ([PRGM]). Notice that you are already in **ALPHA** mode since the A displays in the upper right corner. TI-73: Press [2nd] [TEXT], highlight **C**, and then press [ENTER].	[2nd] [QUIT] [CLEAR] [2nd] [CATALOG] ▼ until **ClrAllLists** is selected [ENTER] [ENTER]	 
3. Setup the list editor with **SetUpEditor**. **Hint:** You also can select **SetUpEditor** on the TI-83 Plus by pressing [STAT] **5**.	[2nd] [CATALOG] ▼ until you highlight **SetUpEditor** [ENTER] [ENTER]	 
4. Display the list editor. **Note:** Lists **L1** through **L6** appear and are clear, and there is a blank list following **L6**.	TI-83 Plus: [STAT] **1:Edit** TI-73: [LIST]	 

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Enter the Lists

In the list editor, enter Jamal's scores as **L1={80,85,90,75,85}** and Jian's scores as **L2={85,70,75,95,100}**.

To Do This	Press	Display (TI-83 Plus shown)
1. Enter data into **L1**.	**80** ▼ **85** ▼ **90** ▼ **75** ▼ **85** ▼	
2. Enter data into **L2**.	▶ (to place the cursor under **L2**) **85** ▼ **70** ▼ **75** ▼ **95** ▼ **100** ▼	

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Display the Sum and Average of All Elements in a List

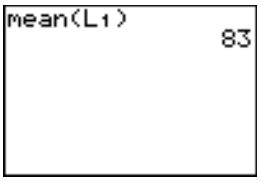
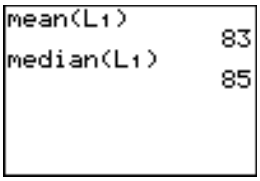
On the Home screen, find the sum of Jian's test scores (**L2**).

To Do This	Press	Display (TI-83 Plus shown)
1. Return to the Home screen and clear the current line, if needed. **Tip:** Once you exit the application, you can press 2nd [QUIT] to return to the Home screen from any menu or command.	2nd [QUIT] CLEAR	
2. Select **sum(** from the **MATH** menu.	TI-83 Plus: 2nd [LIST] ▶ ▶ **5:sum(** TI-73: 2nd [STAT] ▶ ▶ **7:sum(**	NAMES OPS MATH 1:min(2:max(3:mean(4:median(5:sum(6:prod(7↓stdDev(sum(
3. Select the list (**L2**) you want, and display the sum.	TI-83 Plus: 2nd [LIST] **2:L2**) ENTER TI-73: 2nd [STAT] **2:L2**) ENTER	sum(L2) 425
4. Divide **L2** by 5 (the number of test scores) to find the average (or mean) of the list of the scores. **Note**: **Ans** is the previous *answer*, 425.	÷ **5** ENTER **Ans** = 425	sum(L2) 425 Ans/5 85

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Find the Mean and Median of a Set of Data

On the Home screen, find the mean and median of Jamal's test scores (**L1**).

To Do This	Press	Display (TI-83 Plus shown)
1. Return to the Home screen and clear the current line, if needed.	2nd [QUIT] CLEAR	
2. Select **mean(** from the **MATH** menu.	TI-83 Plus: 2nd [LIST] ▶ ▶ **3:mean(** TI-73: 2nd [STAT] ▶ ▶ **3:mean(**	
3. Select the list (**L1**) that you want, and then calculate the mean.	TI-83 Plus: 2nd [LIST] **1:L1**) ENTER TI-73: 2nd [STAT] **1:L1**) ENTER	
4. Select **median(** from the **MATH** menu.	TI-83 Plus: 2nd [LIST] ▶ ▶ **4:median(** TI-73: 2nd [STAT] ▶ ▶ **4:median(**	
5. Select the list (**L1**) that you want, and then display the median.	TI-83 Plus: 2nd [LIST] **1:L1**) ENTER TI-73: 2nd [STAT] **1:L1**) ENTER	

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

On Your Own

Calculate the 1-variable statistics analysis for **L1** using the **1-Var Stats** command on the Home screen. Use the arrow keys (▼ and ▲) to view all of the information about **L1**.

Select the **1-Var Stats** command from this menu:

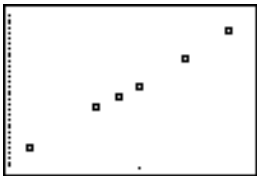
- TI-83 Plus: [STAT] **CALC** menu
- TI-73: [2nd] [STAT] **CALC** menu

Hint: Select the **1-Var Stats** command first, and then select **L1**. For more information about **1-Var Stats**, see the calculator guidebook.

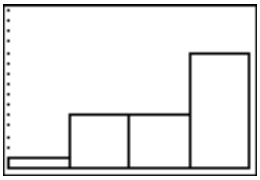
If you are already familiar with statistical plots, find the quartile statistics in the list of data that was generated above, and draw a box plot of the data. For help, see TIp 7: *Creating a Statistical Plot*.

TIp™ 7: Creating a Statistical Plot

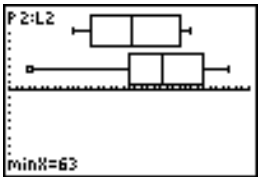
Statistical plots are graphs of data values that have been stored in lists. You can create several types of statistical plots, such as scatter plots, histograms, box plots, and pie charts (TI-73 only).



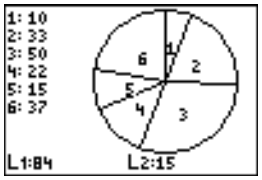
Scatter Plot



Histogram



Box Plot



Pie Chart (TI-73 only)

Calculator Keys Used in This TIp™

- TI-73: 2nd [PLOT]
- TI-83 Plus: 2nd [STAT PLOT]
- ZOOM **ZoomStat**

TIp™ Highlights

In the Try-It! example, you will graph a statistical plot following these main steps.

1. Enter all necessary lists in the list editor.
2. Define your statistical plot in the stat plot editor.
3. Display the statistical plot by pressing ZOOM (**ZoomStat**).

Pressing TRACE allows you to move the cursor from one plotted point to another using ▶ and ◀. It also displays the values (**X**,**Y**) at the bottom of the screen. For more information about statistical plot options, see the calculator guidebook.

Note: The examples in the next section assume that the calculator has been reset to the default settings as described in TIp 1: *Resetting Your Calculator.*

© 2001 Texas Instruments

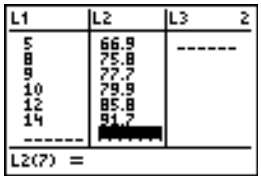
Try-It!™ on Your TI-83 Plus or TI-73

You have collected the measurements (in inches) of how far a boy from age 5 to age 14 could throw a ball above his head. The following data was recorded. Create a scatter plot (⁘) based on these lists, where **L1** = Age in years and **L2** = Distance in inches.

Age in years (L1)	Distance in inches (L2)
5	66.9
8	75.8
9	77.7
10	79.9
12	85.8
14	91.7

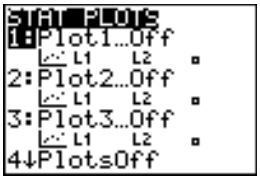
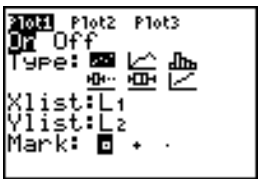
Enter the Lists in the List Editor

See TIp 6: *Using Lists* for step-by-step instructions for entering lists of data (remember to use **ClearAllLists** and **SetUpEditor**). Your list editor should look like this:



Define the Statistical Plot

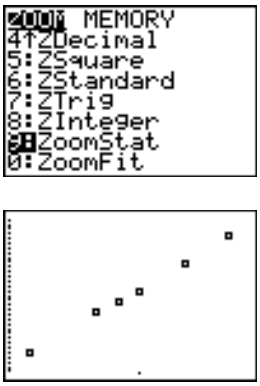
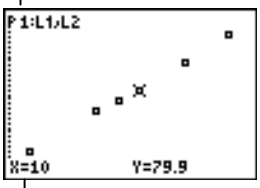
Define **Plot1** as a scatter (⁘) plot where **Xlist=L1** and **Ylist=L2**.

To Do This	Press	Display (TI-83 Plus shown)
1. Display the **STAT PLOTS** screen.	TI-83 Plus: [2nd] [STAT PLOT] TI-73: [2nd] [PLOT]	
2. Display the **Plot1** settings screen.	**1:Plot1**	
3. Select **On** to turn on **Plot1**. **Note: Scatter** (⁘), is already selected because you reset the calculator for this TIp. **Xlist** and **Ylist** do not have to be changed because, by default, they already match our selected lists.	[ENTER]	

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Display the Statistical Plot on the Graph Screen

Display the statistical plot on the graph screen using the **ZoomStat** command and trace it.

To Do This	Press	Display (TI-83 Plus shown)
1. Select **ZoomStat** from the **ZOOM** menu.	TI-83 Plus: [ZOOM] **9:ZoomStat** TI-73: [ZOOM] **7:ZoomStat**	
2. Trace along the statistical plot. **Note: P1:L1,L2** in the upper left corner shows that the lists **L1** and **L2** contain the data for the graph. The data points are displayed at the bottom of the screen.	[TRACE] [▶] or [◀] as necessary	**L1** and **L2** contain the data for this graph.  (**X,Y**) coordinates of the data point at the cursor location.

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

On Your Own

1. Enter the following math test scores in **L1** and **L2**.

Scores (L1)	Frequency (L2)
99	4
96	4
92	3
88	2
84	3
78	2
74	2
70	1
66	1
64	1

2. Set up the histogram (▟▙) where **Xlist=L1** and **Freq=L2** in the **STAT PLOTS** menu.
3. Graph the histogram using **ZoomStat**, and then trace ([TRACE]) the histogram. Letter grades correspond to these test scores: A = 100–90; B = 89–80; C = 79–70; D = 69–60; F = 59–0. Did the graph display the way you expected? Why is it necessary to change the window values manually?
4. Change the window values manually to group the data in intervals of 10. Remember that you want the data grouped in intervals of 10 so you can see how many test scores fall into the grade categories given above. You can tell the calculator to do this by setting **Xscl=10** on the graphing window ([WINDOW]). **Xmin** should be a little less than the lowest score and **Xmax** should be a little higher than the highest score to display a nice graph. Try setting the window as **Xmin=50**, **Xmax=100**, **Ymin=** **-4**, **Ymax=15**, and **Yscl=10**.
5. Graph and trace the histogram again to see why these settings show the grades grouped by scores that match the letter grades A, B, C, D, and F.

Hint: Remember that if you have functions defined and turned on in the Y= editor, the calculator graphs these at the same time as the stat plot. To turn off a function, highlight the = sign next to it, and then press [ENTER].

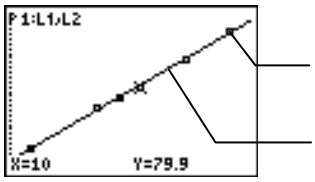
Or you can select **FnOff**. To do this:

- On the TI-83 Plus: Press [VARS] ▶ **4:On/Off 2:FnOff**
- On the TI-73: Press [2nd] [VARS] **2:Y-Vars 6: FnOff**

TIp™ 8: Finding the Best Line of Fit for a Set of Data

Both the TI-83 Plus and the TI-73 have regression commands that automatically find the closest equation to your statistical plot data. The **LinReg(ax+b)** command finds the closest linear equation **y=ax+b** and displays the values for **a** (slope) and **b** (y-intercept) on the Home screen.

You can save this equation in the Y= editor so that you can graph the regression equation and the statistical plot data at the same time, and then compare the two.



Statistical plot data points

Linear Regression line based on statistical plot data

Calculator Keys Used in This TIp™

- TI-83 Plus: [STAT] [▶] (**CALC** menu) **LinReg(ax+b)**
- TI-73: [2nd] [STAT] [◀] (**CALC** menu) **LinReg(ax+b)**

TIp™ Highlights

This TIp shows you how to use **LinReg(ax+b)** on the Home screen to find the linear regression of two list names, **XList** (**L1**) and **YList** (**L2**). You will use the same list values that you used to define the statistical plot.

Note: For more information about statistical plots, see TIp 7: *Creating a Statistical Plot.*

In the Try-It! example, you will find a linear regression following these main steps.

1. Select **LinReg(ax+b)** from the [STAT] **CALC** menu.
2. Enter the two list names that define the statistical plot.
3. Save the equation in the Y= editor.
4. Graph the statistical plot and the linear regression.

Note: The examples in the next section assume that the calculator has been reset to the default settings as described in TIp 1: *Resetting Your Calculator.*

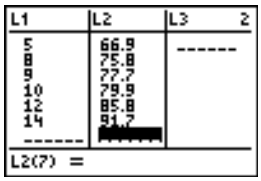
Try-It!™ on Your TI-83 Plus or TI-73

You have collected the measurements (in inches) of how far a boy could throw a ball above his head from age 5 to age 14. The following data was recorded. Create a scatter () plot based on these lists, where **Xlist=L1** and **YList= L2**.

Age in years (L1)	Distance in inches (L2)
5	66.9
8	75.8
9	77.7
10	79.9
12	85.8
14	91.7

Enter the Lists for the Statistical Plot

See TIp 6: *Using Lists* for step-by-step instructions for entering lists of data. Your list editor should look like this:

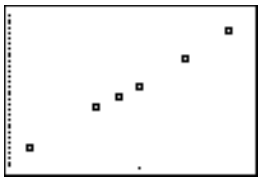


Create a Scatter Statistical Plot for L1 and L2

See TIp 7: *Creating a Statistical Plot* for step-by-step instructions for creating a scatter statistical plot. Your statistical plot editor and scatter plot (using **ZoomStat**) should look like this:



Stat Plot Editor



Graph of Plot

Note: The stat plot editor in the TI-73 looks slightly different.

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Find the Linear Regression for the Scatter Plot

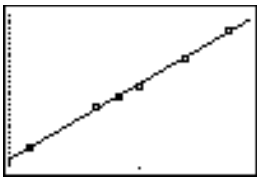
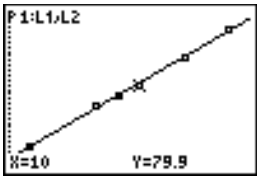
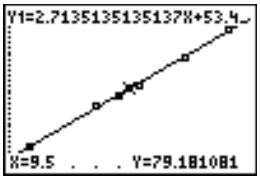
Find the regression (the line which best fits the data) for **L1** and **L2** using **LinReg(ax+b)**.

To Do This	Press	Display (TI-83 Plus shown)
1. Return to the Home screen, and clear it.	2nd [QUIT] CLEAR	
2. Select **LinReg(ax+b)** from the **STAT CALC** menu.	TI-83 Plus: STAT ▶ **4:LinReg(ax+b)** TI-73: 2nd [STAT] ◀ **5:LinReg(ax+b)**	EDIT CALC TESTS 1:1-Var Stats 2:2-Var Stats 3:Med-Med 4:LinReg(ax+b) 5:QuadReg 6:CubicReg 7↓QuartReg LinReg(ax+b)
3. Select the lists **L1** and **L2**.	TI-83 Plus: 2nd [LIST] **1:L1** , 2nd [LIST] **2:L2** , TI-73: 2nd [STAT] **1:L1** , 2nd [STAT] **2:L2** ,	LinReg(ax+b) L1, L2
4. Display **Y-VARS** menu. Then select the Y variable (**Y1**) from the **FUNCTION** menu. 5. Calculate the regression equation.	TI-83 Plus: VARS ▶ **1:Function** **1:Y1** ENTER TI-73: 2nd [VARS] **2:Y-Vars** **1:Y1** ENTER	LinReg(ax+b) L1, L2,Y1 LinReg y=ax+b a=2.713513514 b=53.4027027
6. Display the Y= editor. **Note**: Both **Y1** and **Plot1** are highlighted. This means that both graph and the plot are turned on.	Y=	Plot1 Plot2 Plot3 \Y1■2.7135135135 137X+53.40270270 27 \Y2= \Y3= \Y4= \Y5=

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Graph the Statistical Plot and the Linear Regression

Graph and trace the statistical plot and linear regression at the same time and compare them.

To Do This	Press	Display (TI-83 Plus shown)
1. Select the **ZoomStat** function to display the statistical plot and the regression on the graph screen at the same time.	TI-83 Plus: [ZOOM] **9:ZoomStat** TI-73: [ZOOM] **7:ZoomStat**	 
2. Trace the function or the statistical plot. **Notes**: The function or plot being traced is displayed in the upper left corner of the screen. The **X** and **Y** coordinates display at the bottom of the screen.	[TRACE] [◄] or [►] to trace a function [▲] and [▼] to move between functions	 Tracing along the stat plot  Tracing along the line

On Your Own

Use the function to predict approximately how far you think the boy can throw the ball above his head at 18 years old. Do you think the line will give a good idea of how high this person will be able to throw the ball when he is 35? Explain your thoughts.

Hint: Use the table to determine the value of Y_1 when **X=18**.

TIp™ 9: Sending and Receiving Data between Calculators

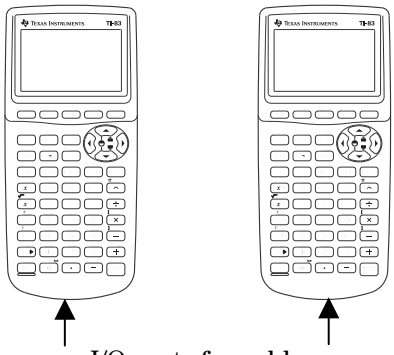
You can send and receive data between calculators using the **SEND** and **RECEIVE** menus.

To connect two calculators using the unit-to-unit cable, which comes packaged with your calculator, use the I/O (input/output) port located at the center of the bottom edge of the calculator.

- Insert either end of the unit-to-unit cable into the I/O calculator port.
- Insert the other end of the cable into the I/O port of the other calculator.

Tip: The cable must be ***firmly*** inserted into the I/O port. If you receive a "link error," make sure the cable is completely inserted.

Sending unit Receiving unit



I/O ports for cable

Calculator Keys Used in This TIp™

- TI-83 Plus: 2nd [LINK]
- TI-73: APPS **1:Link**

TIp™ Highlights

You can send or receive many types of data such as lists, programs, pictures, and applications that can be shared.

To communicate between two calculators, you must set up one calculator to send the data and the other calculator to receive the data.

Note: You can only link two TI-73 calculators or two TI-83 Plus calculators. You cannot link a TI-73 and a TI-83 Plus.

TIp Highlights (continued)

In the Try-It! example, you will link two calculators and send lists of data from one calculator to the other following these main steps.

Receiving Data

After you link the calculators using the unit-to-unit cable, set up one calculator to receive data by following these steps:

1. Display the link menu.
 - TI-83 Plus: [2nd] [LINK]
 - TI-73: [APPS] **1:Link**
2. Press [▶] to display the **RECEIVE** menu.
3. Select **1:Receive**. The message **Waiting…** and the busy indicator are displayed. The calculator is ready to receive transmitted items.

Sending Data

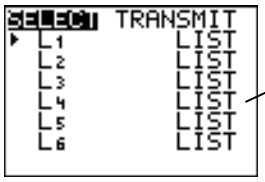
After you link the calculators using the unit-to-unit cable and have one calculator waiting to receive data, set up the other calculator to send data by following these steps:

1. Display the link menu.
 - TI-83 Plus: [2nd] [LINK]
 - TI-73: [APPS] **1:Link**
2. Select the type of data (for example, lists) that you want to send. The corresponding **SELECT** screen is displayed. Each **SELECT** screen is displayed initially with no items selected.

 Note: The **All+** menu item selects all items on your calculator that can be transmitted. The **All-** menu item deselects all items that you have selected to transmit.

Select the type of data.





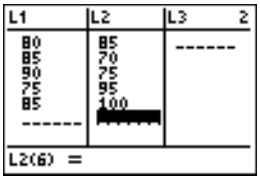
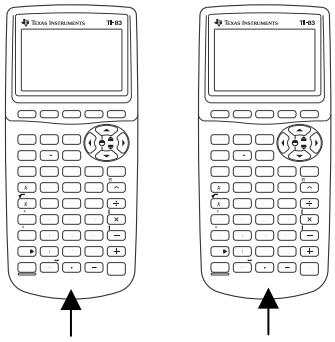
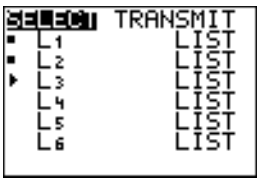
All lists on the calculator are displayed.

3. Press [▲] and [▼] to move the selection cursor (▸) to an item you want to select or deselect.
4. Press [ENTER] to select or deselect an item. Selected names are marked with a box (■). You can select more than one if you want.

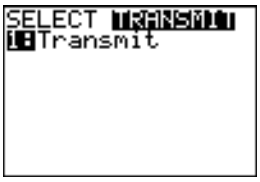
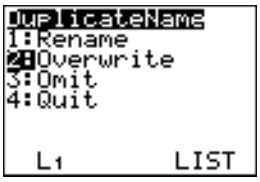
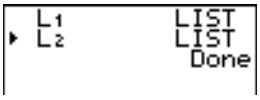
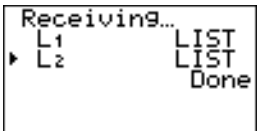
Try-It!™ on Your TI-83 Plus or TI-73

Transfer **L1** and **L2** from one calculator to another one. Use **L1** and **L2** as defined in TIp 6: *Using Lists*.

- **L1={80,85,90,75,85}**
- **L2={85,70,75,95,100}**

To Do This	Press	Display (TI-83 Plus shown)
1. On the sending calculator, enter the lists above in the list editor.	TI-83 Plus: [STAT] **1:Edit** TI-73: [LIST]	
2. Link the two calculators using the unit-to-unit cable.		Sending unit Receiving unit  Connect the calculators with the cable using the I/O ports.
3. On the receiving calculator, select **Receive**. Confirm that **Waiting…** is displayed on the screen. Your calculator is now ready to receive the lists.	TI-83 Plus: [2nd] [LINK] [▶] **1:Receive** TI-73: [APPS] **1:Link** [▶] **1:Receive**	
4. On the sending calculator, display the **SEND** menu, and then select **List**.	TI-83 Plus: [2nd] [LINK] **4: List** TI-73: [APPS] **1:Link** **4: List**	
5. Select **L1** and **L2**. **Note:** The selected lists are marked with a box (■).	[ENTER] [▼] [ENTER]	

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

6. Send the lists to the receiving calculator using the **TRANSMIT** menu.	▶ **1:Transmit**	
7. If the lists have been previously defined, the receiving calculator asks you if you want to: **1: Rename** **2: Overwrite** **3: Omit** **4: Quit** Select **Overwrite** for each list.	**2:Overwrite**	
The name and type of each data item are displayed line by line on the sending unit as the item is transmitted, and then on the receiving unit as each item is accepted. After both lists are transmitted, the message, **Done**, is displayed on both calculators.		 Sending calculator  Receiving calculator

On Your Own

Enter a function in the Y= editor and send it to another calculator.

TIp™ 10: Managing Your Calculator's Memory

You can check available memory, manage memory, and get information about your calculator by selecting items from the 2nd [MEM] **MEMORY** menu. For example, you can find your calculator ID number, which is necessary for registering and installing some applications. A delete menu item lets you delete any type of data (variables, lists, programs, applications, etc.) so that you can set up your calculator with the information you need for your current classes. You can change the data for future classes.



TI-83 Plus



TI-73

Calculator Keys Used in This TIp™

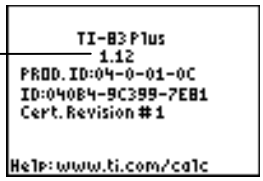
2nd [MEM]

TIp™ Highlights

The **About** screen displays:

- Your calculator operating system version number
- Your calculator ID number, which is used to register and install or reinstall an application

The operating system version number



TI-83 Plus



TI-73

The calculator ID number

As new operating system versions become available, you can download them from the Texas Instruments website. To obtain some applications from Texas Instruments, you must provide your calculator ID number, which is unique to your calculator.

The **Mem Mgmt/Del** menu item lets you delete variables, lists, programs, applications, etc., so that you can set up your calculator with the information you need for your current classes.

The **Reset** menu item lets you reset your calculator default settings. Resetting all RAM on your calculator:

- Restores memory to the factory settings.
- Deletes all programs.

Note: Resetting RAM does NOT erase applications.

To find out more about resetting defaults, see TIp 1: *Resetting Your Calculator*.

Try-It!™ on Your TI-83 Plus or TI-73

Displaying the About Screen

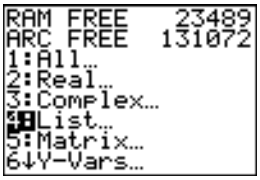
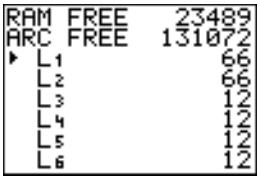
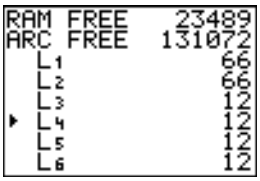
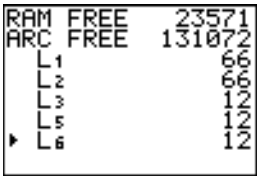
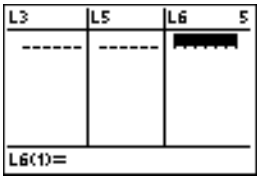
Display your calculator's **About** screen and find the operating system version number and the ID number.

To Do This	Press	Display (TI-83 Plus shown)
1. Select **About** from the **MEMORY** menu.	2nd [MEM] **1:About**	
2. Notice the operating system version number under the name of the calculator (**1.12**) and the **ID** number composed of 14 numbers and letters.		

Try-It!™ on Your TI-83 Plus or TI-73 (continued)

Deleting Items

Delete **L4** from your calculator's memory.

To Do This	Press	Display (TI-83 Plus shown)
1. Display the **MEMORY** menu and select **Mem Mgmt/Del**. **Note:** The TI-73 screen looks somewhat different.	TI-83 Plus: 2nd [MEM] **2:Mem Mgmt/Del** TI-73: 2nd [MEM] **4:Delete**	
2. Select the category, **List**. All existing lists on your calculator display on this screen and the number of bytes of RAM that they use (**L1=66** bytes, etc.).	TI-83 Plus: **4:List** TI-73: **3:List**	 
3. Move the cursor so that it points to **L4**.	▼ to **L4**	
4. Delete **L4**. **Note:** Notice that no confirmation message displayed when you deleted this item. Confirmation messages only display when you delete an item from Flash ROM (an application) or when you delete an archived item. If an item has an asterisk (*) next to it, it is archived (TI-83 Plus only).	TI-83 Plus: DEL TI-73: ENTER	
5. **L4** no longer displays in the list editor. Use the arrow key (▶) to scroll through the lists. **Tip:** See TIp 6: *Using Lists* for information on how to use the **SetUpEditor** to put **L4** back into the list editor.	TI-83 Plus: STAT **1:Edit** ▶ TI-73: LIST ▶	

Hardware and Software Requirements

Hardware and software	Notes
TI-73 with version 1.60 or higher of the Graph Explorer software —or— TI-83 Plus or TI-83 Plus Silver Edition with version 1.14 or higher of the operating system software	You can download a free copy of the latest Graph Explorer or operating system software from education.ti.com/softwareupdates. Follow the link to Operating Systems.
Computer with Microsoft ® Windows® 95/98/2000, Windows NT®, or Apple® Mac® OS 7.1 or higher installed	
TI-GRAPH LINK™ computer-to-device cable	If you do not have this cable, call your distributor, or order the cable from TI's online store.
TI-GRAPH LINK software that is compatible with the TI-73 or the TI-83 Plus —or— TI™ Connect software, which works with all supported models of Flash-based TI graphing devices.	You can download free copies of TI-GRAPH LINK and TI Connect software from education.ti.com/softwareupdates. Follow the link to Connectivity Software.

Deleting an Application

TI-73

1. Press [2nd] [MEM] to display the MEMORY menu.
2. Select **Delete**.
3. Select **Apps**.
4. Move the cursor to the application name.
5. Press [ENTER]. A confirmation message is displayed.
6. Select **Yes** to delete the application.

TI-83 Plus

1. Press [2nd] [MEM] to display the MEMORY menu.
2. Select **Mem Mgmt/Del**.
3. Select **Apps**.
4. Move the cursor to the application name.
5. Press [DEL]. A confirmation message is displayed.
6. Select **Yes** to delete the application.

Installation Error Messages

Low Battery

Do not attempt to download a Flash application if the low-battery message appears on the home screen. Low battery indication is shown on the initial screen. If you receive this error during an installation, change the batteries before trying again.

Invalid Signature or Certificate

Either this device does not have a certificate to run the application, or electrical interference caused a link to fail. Try to install the application again.

Error in Xmit

This problem is usually associated with the unit-to-unit cable and its connection between the devices. Make sure the cable is firmly inserted in the link port of each device.

Communication Error

This error indicates that the TI Connect™ software ("Unable to communicate with device") or TI-GRAPH LINK™ software ("Link Transmission Error") is unable to communicate with the device. The problem is usually associated with the TI-GRAPH LINK cable and its connection to the device or to the computer.

- Make sure the cable is firmly inserted in the device link port and the computer.
- Verify that the correct cable type is selected in the software link settings.
- Verify that the correct communications port (Com Port) is selected in the software link settings. (This does not apply if you use the USB port and TI Connect software.)

Archive Full

This error occurs when the TI-83 Plus does not have sufficient memory for the application. In order to make room for another application, you must delete an application or archived variables from the TI-83 Plus. Before you delete an application from the TI-83 Plus, you can save it on your computer using TI Connect or TI-GRAPH LINK™ software for the TI-83 Plus. You can reload it to the TI-83 Plus later using TI Connect or TI-GRAPH LINK software.

Memory Error

This error occurs when the TI-73 does not have sufficient memory for the application. In order to make room for another application, you must delete an application from the TI-73. Before you delete an application from the TI-73, you can save it on your computer using TI Connect software or TI-GRAPH LINK software for the TI-73. You can reload it to the TI-73 later using TI Connect or TI-GRAPH LINK software.

Other Errors

See Appendix B in the TI-73 guidebook or pages B-6 through B-10 in the TI-83 Plus guidebook for information about the specific error.

Checking Version Numbers and Free Space

Verify Operating System Version and ID Number

The Topics in Algebra 1 application is compatible with TI-73 Graph Explorer software version 1.60 and higher or the TI-83 Plus operating system 1.14 and higher.

To verify your operating system version number:

1. From the home screen, press 2nd [MEM].
2. Select **ABOUT**.

The operating system version number is displayed below the product name and has the format x.yy. The ID number appears on the line below the product number.

Verify Flash Application Version

The version number appears on the information screen below the application name. To display the information screen, do one of the following:

- Press APPS, and then select **MathHand**.

—or—

- Select **INFO** from the application's SELECT AN OPERATION menu.

Check Amount of Flash Application Free Space

TI-73

1. From the home screen, press 2nd [MEM].
2. Select **Check Apps**.

The Math by Hand application requires one free space to load the application.

For more information about memory and memory management, refer to the TI-73 guidebook.

TI-83 Plus

1. From the home screen, press 2nd [MEM].
2. Select **Mem Mgmt/Del**.

The Math by Hand application requires at least 16,384 bytes of ARC FREE (Flash), or one space, to load the application.

For more information about memory and memory management, refer to the TI-83 Plus guidebook.

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For General Information

E-mail: ti-cares@ti.com

Phone: 1-800-TI-CARES (1-800-842-2737)
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Home page: http://education.ti.com/

For Technical Questions

Phone: 1-972-917-8324

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